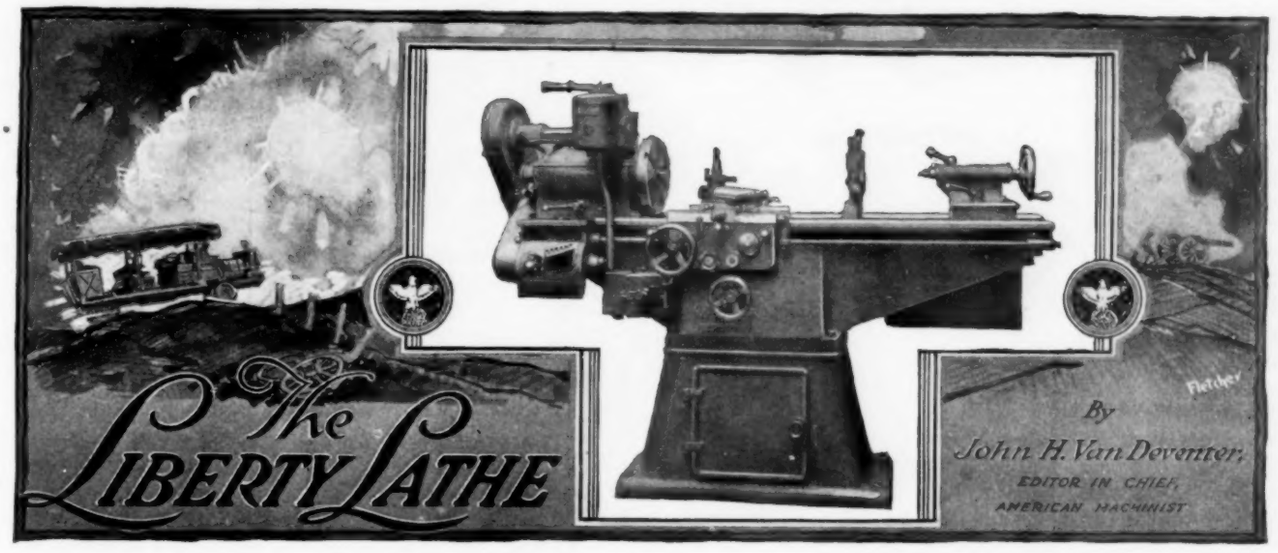
June 12, 1919 American Machinist Vol. 50, No. 24



The Liberty lathe came into being in answer to the call of war—not as a war baby—but to satisfy the difficult requirements of motorized machine shops. So well did it meet the demands for rigidity and minimum floor space that its creators, the Davis Machine Tool Co., Inc., of Rochester, N. Y., after building more than eight hundred of these twelve-inch lathes for the Government, have decided to continue the manufacture of this machine both in belt- and motor-driven types.

MAJ. W. L. KERLIN dropped into the *American Machinist* office the other day on his way home from France. Most of his year "over there" was spent in running mobile repair shops. The Major, as befits a man who has been born and brought up in a machine shop, is a go-getter.

During the time that Kerlin was stationed in Washington, before getting overseas, it was necessary to build (overnight) a dark room so that manufacturers of war materials could get photostats. It would have taken seven years to have gotten the order for lumber for this "odd job" through the intricacies of the War Department. This did not faze the Major who went on a still hunt through the streets of Washington until he found a load of lumber being unloaded. By virtue of nerve and the moral effect of a brand-new uniform, Kerlin hornswoggled the reluctant driver into reloading this lumber and depositing it at 1330 F St., N. W. Probably that load of lumber is one of the Government's unsettled claims at the present date, but anyway the dark room was completed, and manufacturers got their photostats.

Later on in France our friend, Kerlin, who had the job of keeping the guns of a certain sector in firing order, found it necessary to get some spare "cradles" for 75's. At the base depot he encountered an officer of superior rank who in a former incarnation had evidently been a rigid adherent to scientific system. This officer informed Kerlin that the order he had brought with him for these cradles was made out on the wrong kind of a form.

"Do you see that truck over there?" inquired Kerlin.

"Yes," assented the scientific-system disciple.

"That's my truck," Kerlin informed him. "Do you see that gang out there in the yard? That's my gang. These cradles are your cradles, I'll admit, but they are going on my truck, system or no system, and if you don't believe it, call out *your* gang and we will see who wins the argument!"

Kerlin got the cradles without going back for another order form.

But what has all this got to do with the Liberty lathe? At least it gives you an idea of the kind of go-getters who ran these motorized machine shops and that such men would not spare wear and tear of equipment to get results. These shops had the hardest kind of usage. They were as likely to land in a ditch or a plowed field as to continue on the road. A level floor was the one thing you could never expect. Thus the ordinary four-legged lathe rested uneasily on such a variable foundation.

In answer to the Government's requests, the Davis Machine Tool Co. designed a single pedestal-leg lathe for this exacting service. It is shown in the title illustration of this article. George E. Randles who was in charge of the Maintenance Division of the Motor Transport Corps christened it the "Liberty lathe." Of course it was motor driven as were all of the tools on these portable machine-shop units. It was a lathe that would preserve its alignment and do accurate work in spite of the shaking and pounding inevitable in this service, and at the same time so simple and easy to operate that

the rookie machinist could make good on it. To reduce the strain and the tendency to spring to a minimum it was necessary to develop a cantilever type of bed which, when all parts were attached, would bring the center of gravity of the unit directly over the single cabinet leg. In following this plan, contrary to the usual practice on motor-driven lathes, the motor and as much other weight as possible was removed from the top of the headstock. The motor was mounted on the back of the bed about in the center as shown in Fig. 1. It drives through a long heavy shaft supported at the headstock end by a bracket bearing, thence through a Morse chain drive in an oil-tight guard to a jackshaft in the hood over the tailstock and thence to the spindle of the machine through a system of gearing.

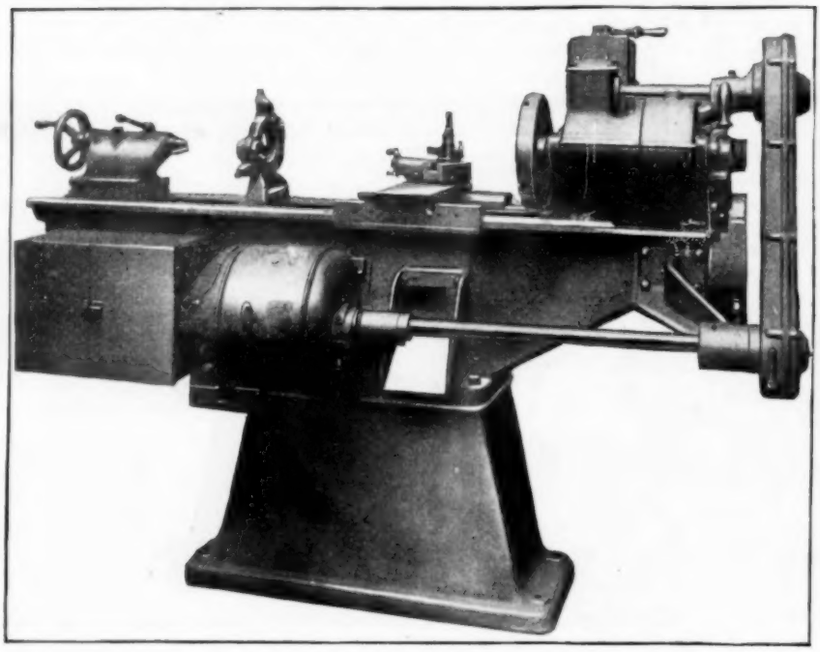
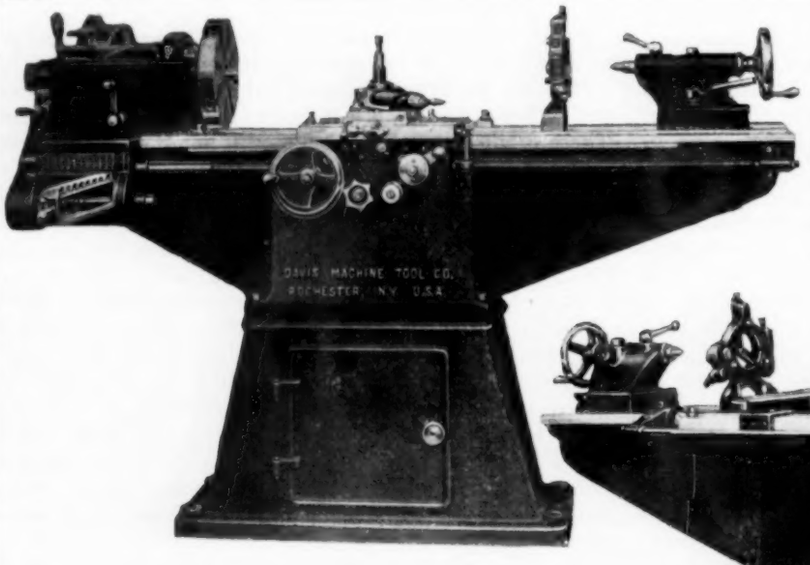
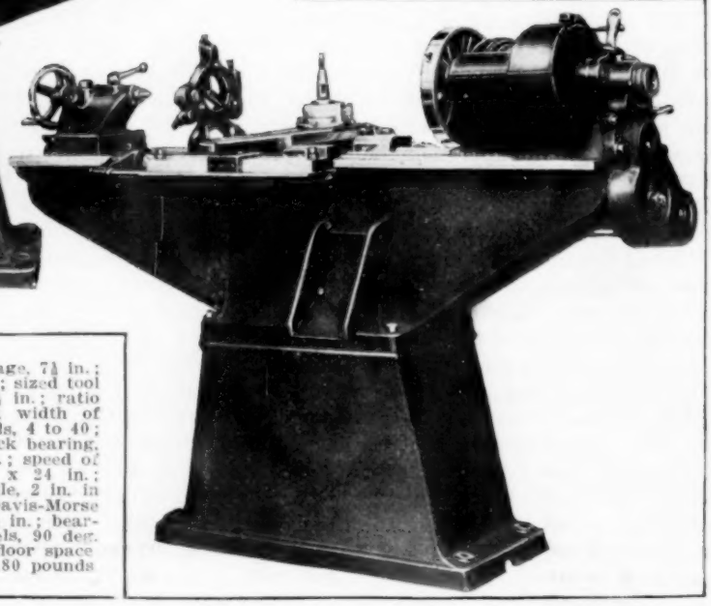


FIG. 1. REAR VIEW OF DAVIS 12-IN. LIBERTY LATHE, MOTOR-DRIVEN TYPE, AS FURNISHED FOR MOTORIZED MACHINE SHOPS

This location of the motor as you see it in Fig. 1 made it possible to economize space by getting the motor to go into the space under the driver's seat. This pedestal type of lathe with its cantilever-shaped bed enabled the introduction of another feature which is both an innovation and convenience. This is a chip chute. All chips falling between the ways follow the inclined surfaces of the bed box and come out of this chute insuring freedom from chips. The motor has an armature speed control of three to one and is controlled by the hand-wheel located in the bed below the apron. Starting, reversing or brake action is secured by the starting box lever which you can see just above the headstock.

This lathe as it was used on motorized repair shops did not include the lower pedestal. The cabinet leg of





FIGS. 2 AND 3. FRONT AND REAR VIEWS OF LIBERTY LATHE ARRANGED FOR BELT DRIVE. NOTE CANTILEVER BED CONSTRUCTION AND CHIP CHUTE

Specifications: Length of bed, 6 ft.; swing over carriage, 7½ in.; swing over ways, 13½ in.; takes between centers, 42 in.; sized tool ordinarily used, ½ x 1 in.; capacity of center rest, 3½ in.; ratio of back gears, 8½; cone diameter, 6¾, 5⅛, 4¾ in.; width of belt, 2 in.; diameter of tail spindle, 1 5/16 in.; cuts threads, 4 to 40; hole in spindle, 1 1/16 in.; front bearing, 1⅞ x 2¾ in.; back bearing, 1½ x 1¾ in.; size of pulleys on countershaft, 8 x 3¼ in.; speed of countershaft, 290 and 350; base of cabinet leg, 13 x 24 in.; height from top of base to ways, 17 in.; nose of spindle, 2 in. in diameter, 8 threads per inch and bored to No. 4 Davis-Morse taper; spindle, 23 to 500 r.p.m.; tail spindle travel, 5¼ in.; bearing of carriage on ways, 14⅛ in.; compound rest swivels, 90 deg. either way; size of box for export, 31 x 55 x 80 in.; floor space 28 x 76 in.; net weight, 1481 lb.; boxed for export, 2180 pounds

the bed was bolted with four screws to a special wooden bench with drawers containing tools and supplies.

As a peace-time product the Davis Machine Tool Co. is putting this lathe out in two forms, belt and motor driven. The latter corresponds to the design which has just been described. The belt-driven machine follows the same general design and dimensions and retains the chip-chute feature while of course discarding the motor and the auxiliary jackshaft. In the belt-driven machine the drive is through a three-step cone and there are double back gears shifted with the lever shown mounted on the top of the headstock in Fig. 2. There are 18 spindle speeds ranging from 23 to 500 r.p.m. in geometric progression, with a double-speed countershaft running at 290 and 350 revolutions per minute.

A quick-change gear box operates in conjunction with the feed lever and is located on the front side of the headstock. It permits a change of threads or feeds ranging from 4 to 40 per inch and includes 30 steps. Feed reverse is operated by a tumbler lever on the side of the headstock and can be safely thrown while the machine is running. The tailstock is offset to allow the compound rest to swivel parallel to the bed and is provided with a set-over for turning tapers. Some of the principal dimensions and characteristics of this machine are given in the specifications.

This step in lathe design toward a pedestal and cantilever bed construction appears to be more in the right direction. The rigidity and compactness of this machine should make it useful not only for any kind of portable service, or where there are vibrating floors, or on shipboard, but also for toolrooms and production departments.

Shop Democracy and Dividends

BY HARRY SENIOR

I am writing under the above title, not because I have anything to say about democracy or dividends, but because my friend John R. Godfrey (who didn't say anything about them either) chose this title for his letter on page 586 of the *American Machinist*. Mr. Godfrey's real subject is the foreman, and in that subject I am interested, for I believe that wherever the present-day machine shop has fallen down, it has been largely due to the limitations of the "old man," as we used to call him.

"The foreman of the little old shop of yesterday was an autocrat with a capital A." So he was—Heaven bless him—and if he isn't today—and tomorrow—he isn't a foreman, but please remember that the very best and most efficient form of government in the world is that of an autocrat with brains and a soul inside of him; splitting up the autocracy into a dozen or more personalities and leaving out the "works" isn't an improvement.

The kaiser (please spell this with a little k) was never an autocrat; he was the mouthpiece of a heartless, soulless, and in some respects brainless, oligarchy. He was an egotist of the most obnoxious type, and, standing alone, would not have lasted six months as the head of a government. The same kind of personality in the little old shop of yesterday would not have lasted even that long. The conditions with which he had to deal would put him out of business.

He could not control good men. He could not depend upon the willing coöperation of other people with whom he was obliged to do business: suppliers, transporters, bankers, and such. The boss in the other little shop down the street, he whose iron rod of autocracy was thickly coated with the diplomatic velvet of consideration for other people, the man for whom others did things because they liked him entirely aside from any cash remuneration, could put it all over the former in the matter of workmanship and prices because his place was full of good workmen who were all enthusiasts for the success of "our shop."

If by any chance a shop existed that was presided over by a foreman who would "fire the best man on the premises because he didn't like the color of his necktie," the best man was probably such a grouch that he couldn't hold a job elsewhere, and his necktie, if he wore any, was very likely something fierce.

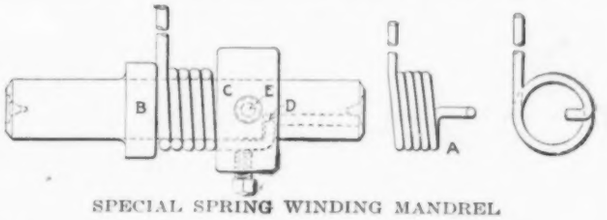
The little old shop of yesterday has become a department in the big new shop of today. The old autocratic (?) foreman has become a minion who has no right to opinions and ways of his own, but must reflect the policies of the oligarchy that controls his destiny as well as the destinies of the men who are responsible, not *to* him but *through* him to IT. Business, from being a means of making a living, has become the exponent of power, a juggernaut to crush everything before it that opposes its progress, and at the same time a shield behind which men with the will but not the ability to become autocrats may take refuge from the remnants of their conscience under the plea that a "corporation has no soul."

This condition may make for efficiency—the German government did—but it also leads to such things as I. W. W., Bolsheviki, Spartacusses, etc. As a writer in these columns in dealing with this subject (Vol. 49, page 143) once said: "We are not running shops as we did 40 years ago." Truly, we are not—neither did we have any of the things mentioned above. Is it not possible that the conditions that produced them in Germany are in some way related to the conditions that produce them here? For the love of Mike—if that happens to be his name—let us take a little more human interest in, and show a little greater consideration for, the other fellow, whatever his station.

A Mandrel for Winding Special Springs

BY H. D. CHAPMAN

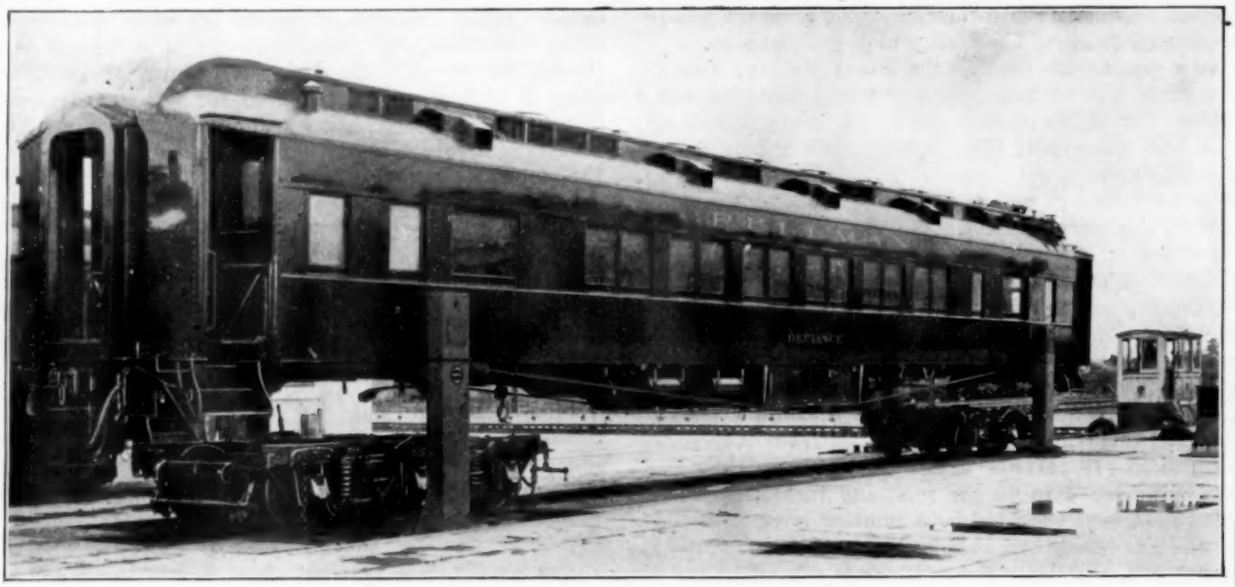
The sketch shows a mandrel for winding special springs, of which we had a large number of the shape shown at *A*. The mandrel was made as shown at *B* with the collar *C* a sliding fit. The wire was about 0.128 in.



SPECIAL SPRING WINDING MANDREL

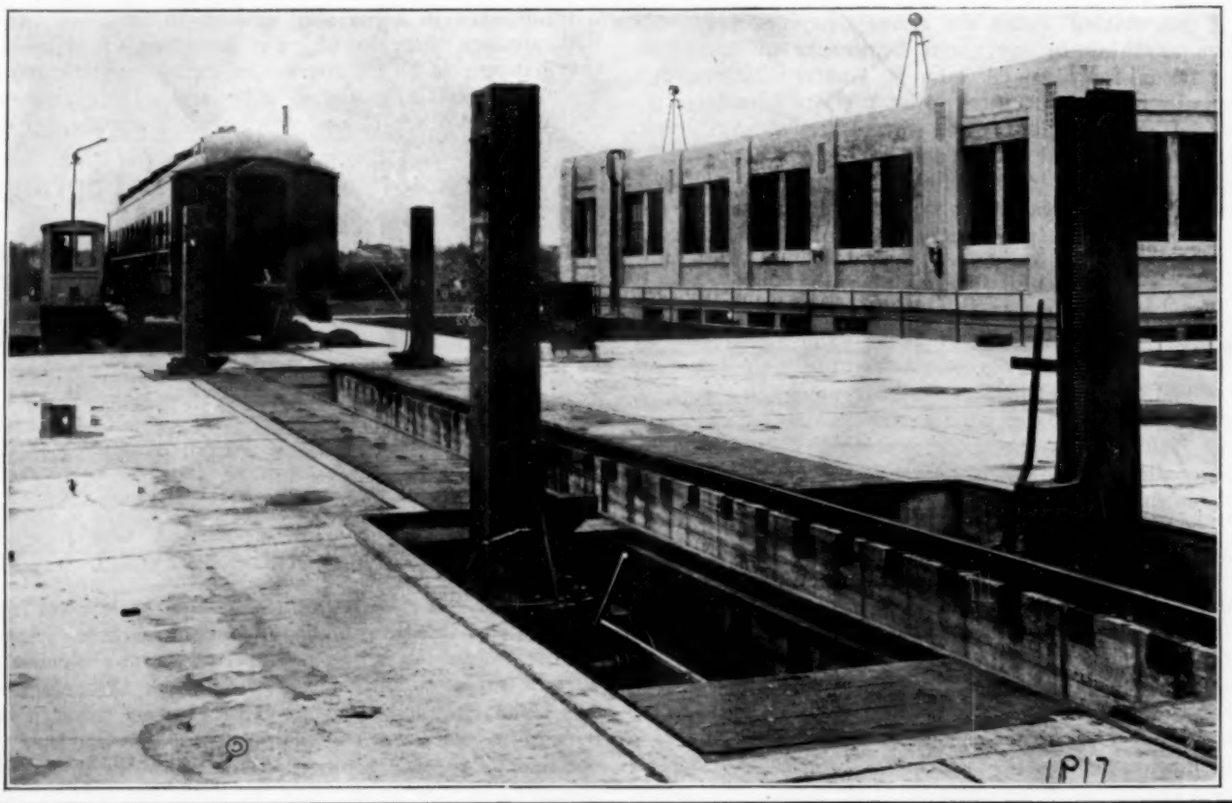
in diameter and was cut to length so it would wind into the required length and shape of spring without waste.

There is a hole in the mandrel at *D* into which the wire was placed and bent down flat on the mandrel. The collar, which has a groove or channel through its bore to fit over the wire, was pushed over it and held in position by the taper pin *E*. A setscrew in the collar clamped the wire so it would not draw out of position, while it was being wound.



Electric Screw-Jack Coach Hoist

THE installation shown is for speeding up the removal and replacement of trucks on railroad, interurban or street cars. It was built by the Whiting Foundry Equipment Co., Harvey, Ill., installed in a large car shop in St. Louis, Mo., and does away with the hydraulic or hand jacks customarily employed, overcoming the risks usually incurred in this operation. The machine consists of four screw jacks, two of which may be moved along the track to accommodate cars of different lengths, each jack being equipped with a heavy step that is operated by a screw mechanism. After the four steps have been adjusted to the car sills, all four jacks are connected by clutches, and when the power is turned on, rise at the same speed, thus keeping the car level. The equipment is electrically operated and is said to be a great time saver.



Tools for Locomotive-Valve Parts

By FRANK A. STANLEY

The tools here described include the equipment for machining parts of boiler check valves and oil-feed valves and are made up of box tools, boring tools, valve-seating reamers, taps, dies, etc. They are covered fully by the illustrations reproduced from line drawings and photographs.

OF THE many lines of work done at the Sacramento shops of the Southern Pacific Co. the one that claims the present attention is the manufacture of oil-feed valves, boiler check valves and other devices of similar character used on the various kinds of locomotives employed by this system.

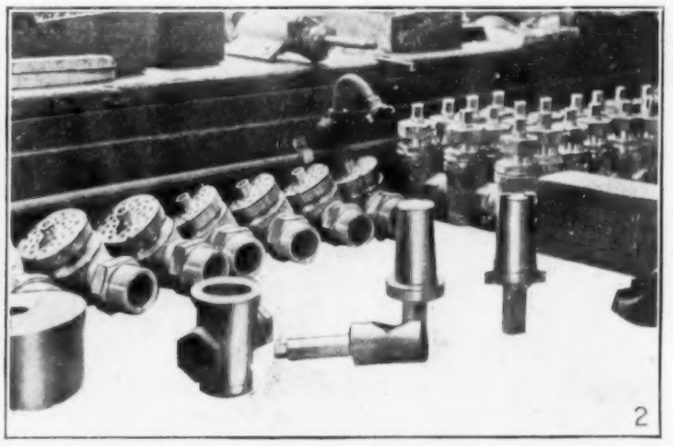
The two views, Figs. 1 and 2, of one of the benches in the brass shop of the plant, show a number of oil-feed cocks assembled, and in the foreground of Fig. 2 are the body and plug of one of the cocks and a pair of taper reamers for finishing the body to receive the taper plug.

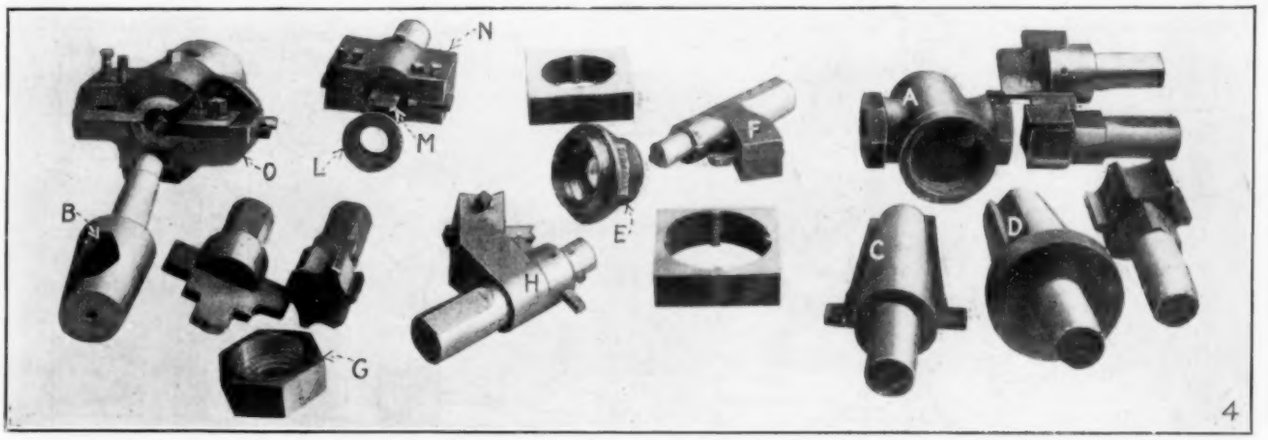
One of these oil-feed cocks is shown complete in Fig. 3, and the tools for all parts are reproduced in Figs. 4 and 5.

In Fig. 4, *A* is the body of the valve, and *B* the taper plug. The operations on the body are performed with the casting held in special chuck jaws, but the plug is turned on the lathe centers. The taper hole in the body is produced with the two reamers *C* and *D*, Figs. 4 and 5.

Reamer *C* is made with two $\frac{5}{16}$-in. tool-steel blades inserted in a solid taper body $1\frac{1}{2}$ in. in diameter at the small end, or $\frac{3}{8}$ in. under the blade diameter. The inserted blades are formed near the rear ends to bore out the $3\frac{1}{4}$-in. diameter for tapping to $3\frac{1}{2}$ in., and to face off the end of the work for the guide for the stem. Reamer *D*, which is the finishing reamer, is made with two plain taper blades inserted in a taper body carrying at opposite sides a pair of fiber strips, as indicated, which steady the reamer in the hole and prevent it from chattering.

The guide *E* for the valve stem is bored in front for the $1\frac{1}{4}$-in. stem, chambered out to $1\frac{3}{4}$ in. and formed with the 30-deg. seat for the packing by means of the





FIGS. 1, 2 AND 4. OIL-FEED COCKS AND THE TOOLS FOR MAKING THEM
Figs. 1 and 2—Bench in brass shop showing work and tools. Fig. 4—Group of tools for oil-feed cocks

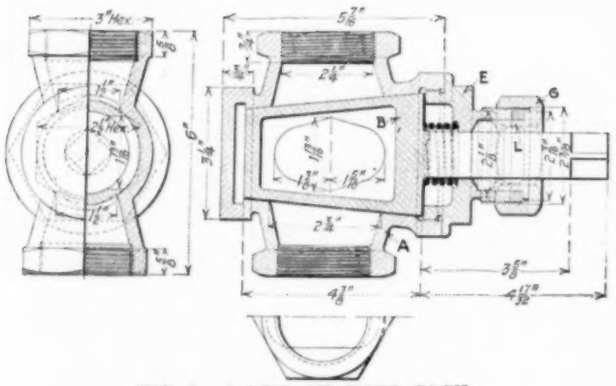


FIG. 3. A 2-IN. OIL-FEED COCK

boring cutters in the tool *F*, which carries also a turning tool for machining the outside of the neck to $2\frac{3}{8}$ in. for threading to receive the nut *G*. The same combination toolholder carries a crosswise cutter for facing the outer end of the stem guide to length. The $1\frac{5}{8}$-in. chamber for the end of the spring in the front of member *E* is bored out by the combination tool *H* carrying a cutter of that length in front, a $\frac{7}{8}$-in. facing cutter further back and a turning tool at *I* for the large diameter that is afterward to be threaded. The pilot of toolholder *H* is $1\frac{1}{8}$ in. in diameter, which is the size of the hole bored in an earlier cut by the tool in the outer end of holder *F*.

Chambering and Facing

The nut *G* is bored out, chambered and faced at the inner side by the tools *J* and *K*, the latter establishing the depth of chamber for the gland. The gland *L* is bored and faced to an angle of 30 deg. by tool *M* in holder *N*, and the outside turned to a diameter of $1\frac{3}{4}$ in. by the flat cutters in the sides of the box tool *N*, these also facing the shoulder of the gland. The box tool at *O* is used for turning the stem of the plug *B* and for facing off the end to length; also for putting in a center and countersinking it.

The various dies and taps in the views referred to are readily identified with the threads they are used for producing.

Another piece of work made in quantities is the boiler check valve for locomotive injectors illustrated in section and elevation in Fig. 6. This is another case where special chuck jaws are a great convenience in holding the main casting while performing various operations in the lathe, the body of the valve having a spherical form with connections leading off at right angles to each other.

The valve body is shown at *A*, Fig. 7, all the tools shown being used for the body and ball joint nut, while the set of tools for the valve and the cap are shown in Figs. 10 and 11. Fig. 8 shows the tools for the body and for the connection, Fig. 9.

Boring and Reaming Tools

Referring to Figs. 7 and 8 the tool *B* is used for boring the hole in the top of the valve body for the cap *C*, Fig. 6, and for boring the chamber under the valve seat and forming the seat *D* for the cap; the

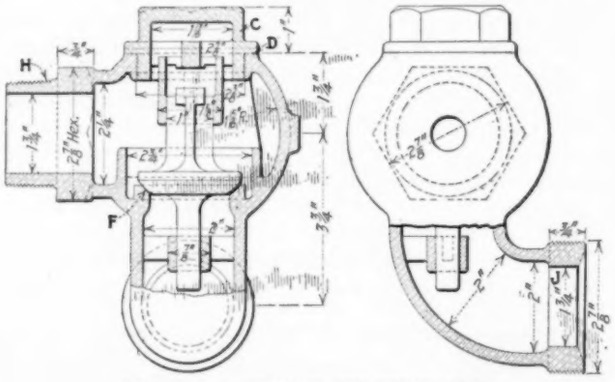


FIG. 6. A BOILER CHECK-VALVE

same tool also drills the valve-stem hole. The latter is done with a $\frac{3}{4}$-in. twist drill carried in the end of the boring bar. A cutter $1\frac{3}{4}$ in. long bores the neck for the valve chamber, and another cutter $2\frac{1}{16}$ in. across bores the hole in the top of the body for the threading

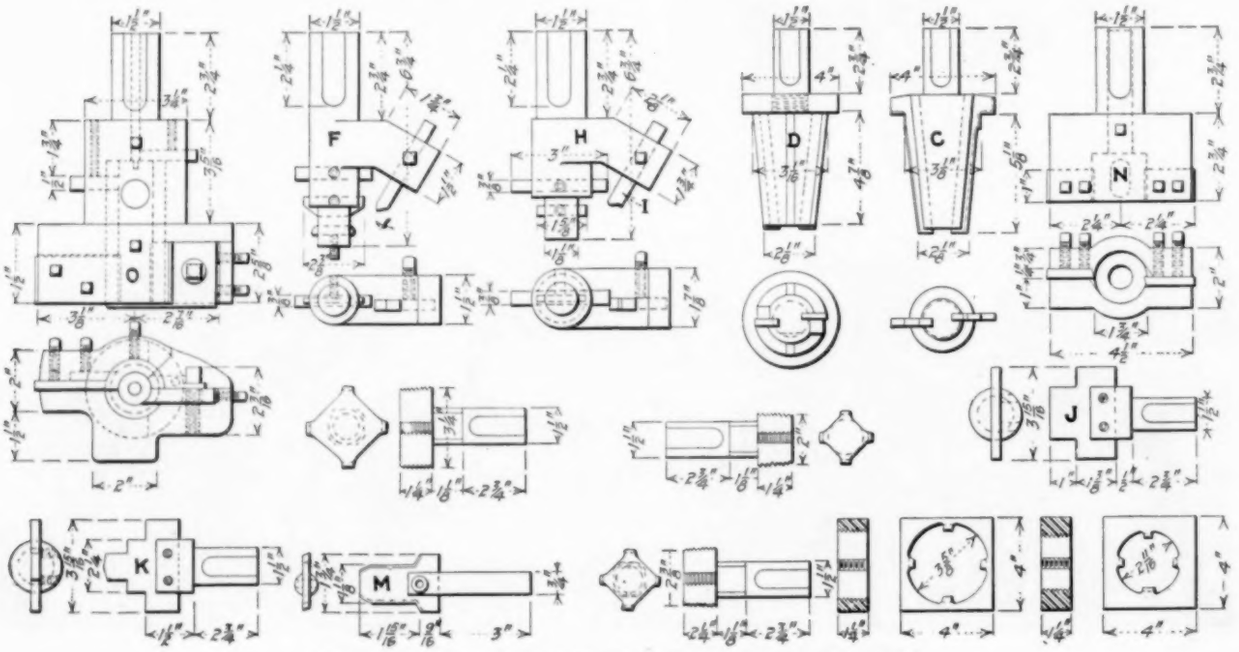


FIG. 5. DETAILS OF LATHE TOOLS FOR OIL-FEED COCKS

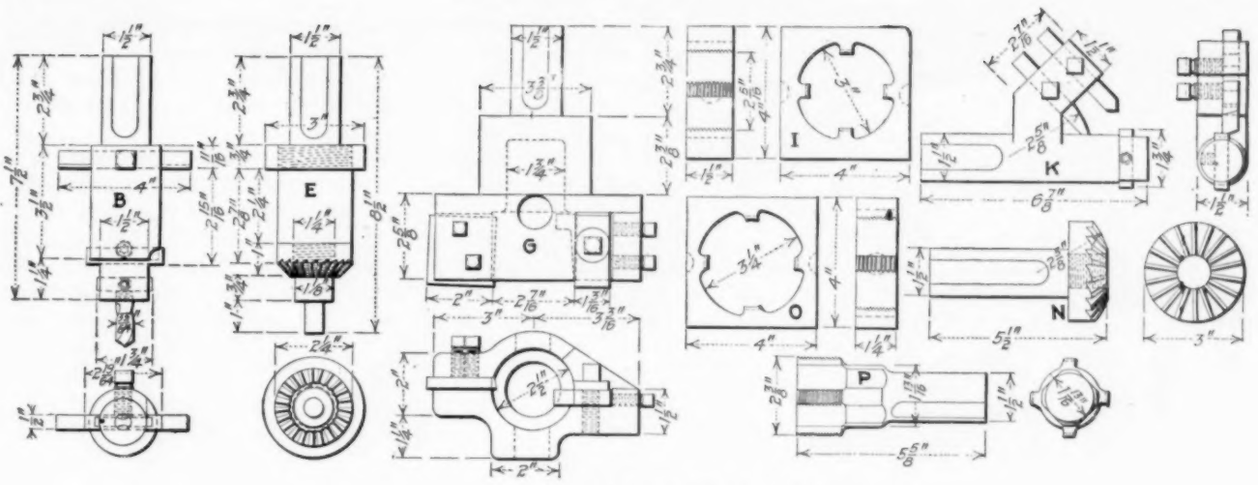


FIG. 8. DETAILS OF CHECK-VALVE TOOLS

for the cap. The same bar carries the 4-in. cutter for facing off the seat for the cap.

A second tool of similar proportion is shown at *E* for forming the valve seat at *F*, Fig. 6. This cutter is 2¼ in. in diameter, and the seating tool is formed with 19 teeth. The outer end of the bar is provided with a ¼-in. pilot threaded on its enlarged shank and screwed into the end of the bar. The pilot is guided in the hole drilled in the lower part of the valve body for the valve stem. The tap for threading the top of the body for the cap is shown at *F*.

Finishing the Pipe Connection

At *G*, Fig. 8, is shown a box tool that is utilized for turning and facing the 2-in. pipe connection *H* at the side of the valve, Fig. 6. The broad-faced cutters are set at an angle in the holder corresponding to the taper of the pipe thread, and the inner end of one of these cutters has a projecting lip to form and finish the outer end of the connection. The die at the side at *I* is for threading this connection.

Ball-Joint Tools

The ball-joint connection at *J*, Fig. 6, is first bored, turned and faced to a radius by means of the tool *K*, Figs. 7 and 8, which carries a 1¾-in. boring cutter near the outer end, a turning tool for sizing the outside for the thread at *L*, and another tool at *M* for roughing-out the ball seat to a radius of 2⅝ in. These two tools are placed at an angle so that they can be readily adjusted to hold the work to the required diameter and depth of radius.

The finishing tool for the spherical seat is shown at *N*, Figs. 7 and 8. It is a solid tool cut with 18 teeth, all to the radius of 2⅝ in. and secured to the shank by a threaded end on the latter. The die for threading the joint for the coupling nut is shown at *O*.

The coupling nut is shown by the detail, Fig. 9. It is also seen at *P*, Fig. 7. It merely requires threading internally, and the tap for the purpose is indicated at *Q*, Fig. 7.

Finishing Valves and Caps

The shape of the valve and some of its dimensions are seen from the drawing, Fig. 6. Also two views are given in Fig. 10, which also shows two box tools used for turning the two ends of the brass casting

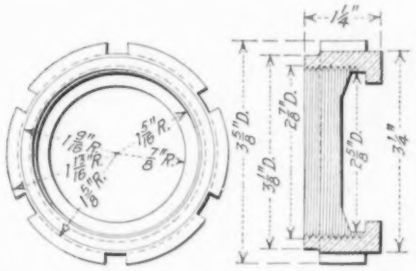


FIG. 9. COUPLING FOR AN INJECTOR PIPE

which forms the valve. The box tools are shown in Fig. 11.

The tool at *R*, Figs. 10 and 11, is for turning the winged end, or spindle, of the valve, facing off the outer

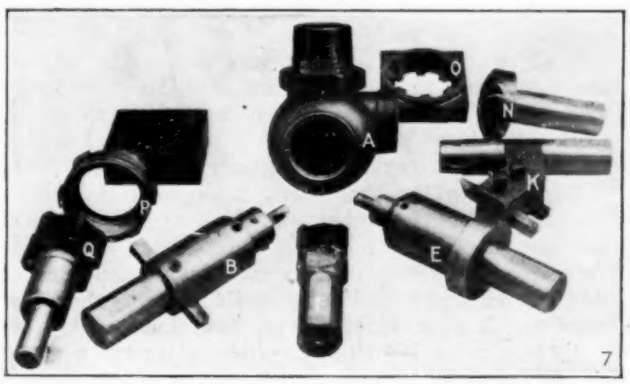


FIG. 7. TOOLS FOR THE BODY

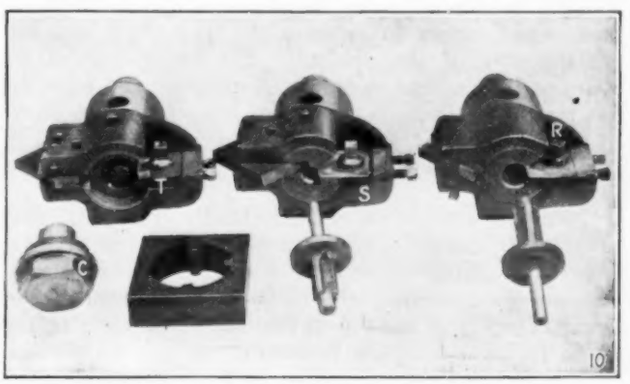


FIG. 10. TOOLS FOR THE VALVE AND CAP

end, and turning the outside diameter of the valve disk itself. The next tool *S* is for facing off the side of the valve, turning the stem to $\frac{1}{2}$ in. in diameter and forming the seating surface to an angle of 45 deg. The cutter that does the turning and facing of the under side of the valve is a broad-faced tool with a $\frac{3}{4}$-in. round corner to produce the fillet in the stem.

The Valve-Cap Tools

The box tool at *T*, Figs. 10 and 11, is for machining the valve-guide cap *C*, Figs. 6 and 10. In this box tool the cutter *A*, which has three shoulders, accomplishes the turning and facing of the pilot on the valve-guide cap, which has a diameter of $1\frac{3}{4}$ in., and it also turns the body for threading to a diameter of $2\frac{3}{4}$ in., at the same time facing the under side of the flange on the cap. Simultaneously with the outside-turning operations the inside of the cap is bored out to a diameter of 1 in. by the cutter *B*, which is carried in a round shank inserted in the center of the tool as represented.

The die at *U*, Fig. 11, is for threading the lower end of the cap. The cap to the left is for tapping out the ball-joint cap, and it has been described elsewhere in this article.

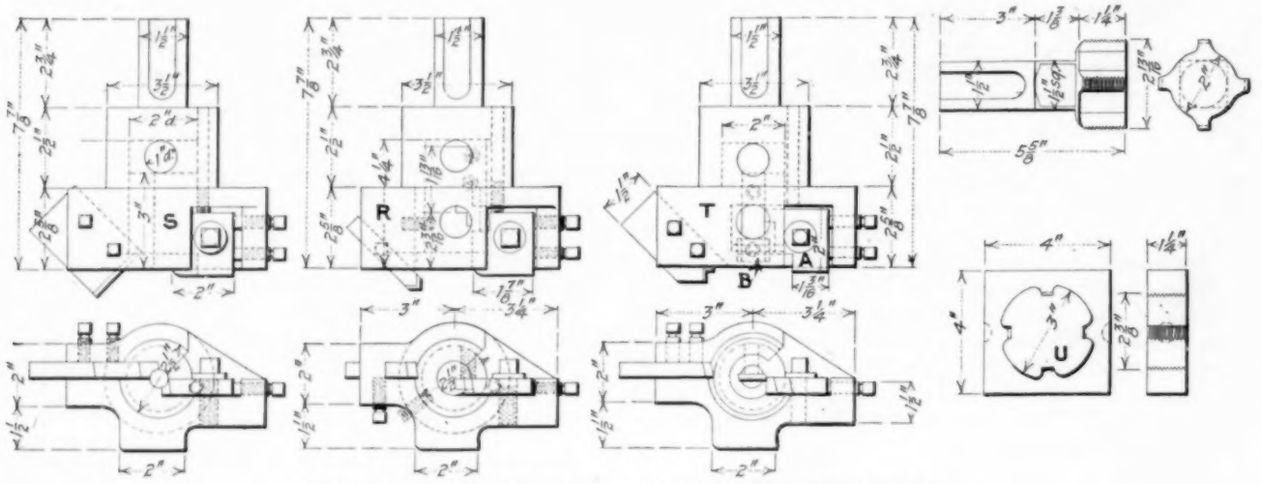


FIG. 11. DETAILS OF TOOLS FOR CHECK-VALVES AND CAPS

A Few More Jots of a Journeyman

By M. L. Lowrey

In an article on page 483 of *American Machinist* F. L. Ess asks what a journeyman should do with any ideas he might have relative to the work in which he is engaged, either to improve the quality or increase the quantity of the product. The experience of 35 years as journeyman machinist, toolmaker, and foreman has taught me that, on account of the innate cussedness of human nature, these ideas are very dangerous things for a man to fool with if he wants to stay long in one place.

To begin with there is, unfortunately, a great deal of jealousy among the workmen, and those with little inventive genius view with suspicion the man who has an idea, particularly if he is a newcomer, and immediately start the report that the new man is trying to curry favor with the foreman.

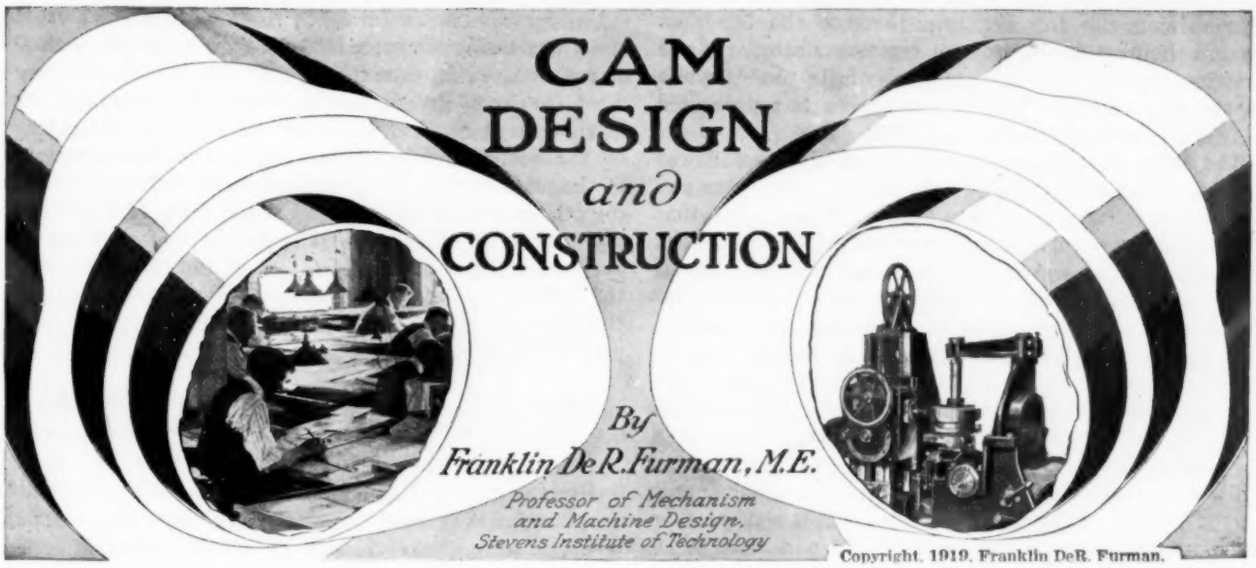
One such man once said to me: "How much stock have you in this company anyway? and what a brainy man you must think you are; we have made these things this way for the last 10 years, and a plenty good enough way it is too, and now you come here and cut down the time and will be getting some of us laid off for lack of work if you keep on."

When this feeling gets all through the shop, it is almost impossible for the man with ideas to stay unless he is fortunate enough to get into the toolroom. Even a toolmaker, however, must be very careful as, again unfortunately, too many foremen regard an idea coming from one of their men as a reflection on their intelligence, or at least their attention to the business, and immediately snow it under until they can get rid of the man and then spring the idea as their own. Again, if a man takes his idea to the manager without consulting his foreman—*goodnight*.

As I am one of those who are blessed or cursed with ideas and just *have* to work them out, I have adopted a plan that works fine, although there is not much money in it, and for the benefit of the craft I give it here as the best I have after working at the trade all these years. When I am working at a job that I don't like and don't expect to stay long, and have an idea, I make a note of it in a book that I keep for that purpose for future reference and that ends it so far as that shop is concerned. If I do like the job and want to stay, I wait until my superior officer, be he foreman, superintendent, or manager, is in what I think the proper mood. I then attract his attention, usually by having the piece I wish to improve upon, or the drawing of it, where he can see that I am studying it. When he asks what I am doing, I talk of the various operations to be performed on it and artfully (?) lead him (here is where the fine work comes in) to make the suggestion that I want him to make, then I say: "*That is a bully idea*, you just let me go ahead and work that out." Then having his permission I work it out in my own way and everybody is happy.

The men in the shop think it is all right, as the idea came from the higher ups; the boss is pleased with his invention and thinks that I am a man of superior intelligence to catch his idea so quickly; and I get to do the work that I most enjoy, besides having the knowledge that I have helped the company that employs me.

In conclusion I wish to say that I am not a grouch or pessimist, nor is my experience at all exceptional. "'T is true, 't is pity; and pity 't is, 't is true."



V. Cams With Swinging Arms

This, the fifth installment, deals with swinging follower arms with both roller and sliding contact, pointing out the special nature of the pressure angle in each case, the results that follow from differently locating the center of the swinging arm, the method of finding the length of shoe for the sliding arm, and the limited use in general of flat surface followers.

IN THE previous problems the motion of the center of the follower roller has been in a straight line. When the center of the roller moves in a curve a different method of construction is used to advantage. Cams with swinging followers are illustrated in Figs. 45 and 46, the arc of swing *AV* of the follower having its extremities on a radial line in the former illustration; and on an arc which, continued, passes through the center of the cam in the latter illustration. These two forms of construction, although apparently differing in only a slight detail, give quite different results, and each has its own particular field of usefulness. A comparison of the results will be given after a problem in each case has been worked out.

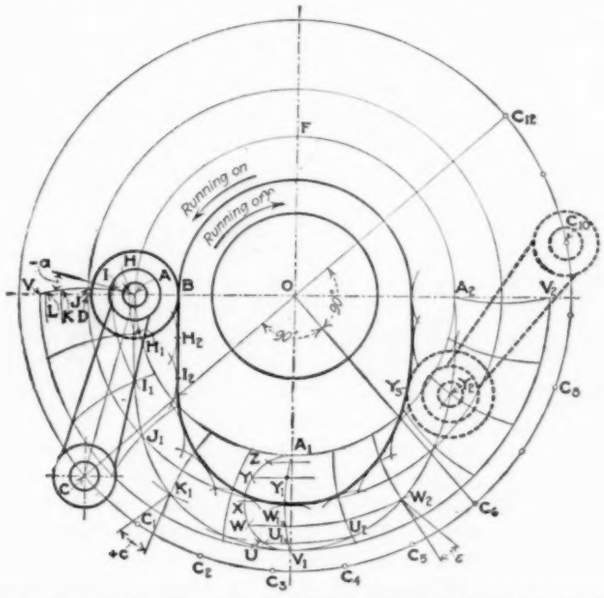


FIG. 45. PROBLEM 8, CAM WITH SWINGING FOLLOWER ARM, ROLLER CONTACT—EXTREMITIES OF SWINGING ARC ON RADIAL LINE

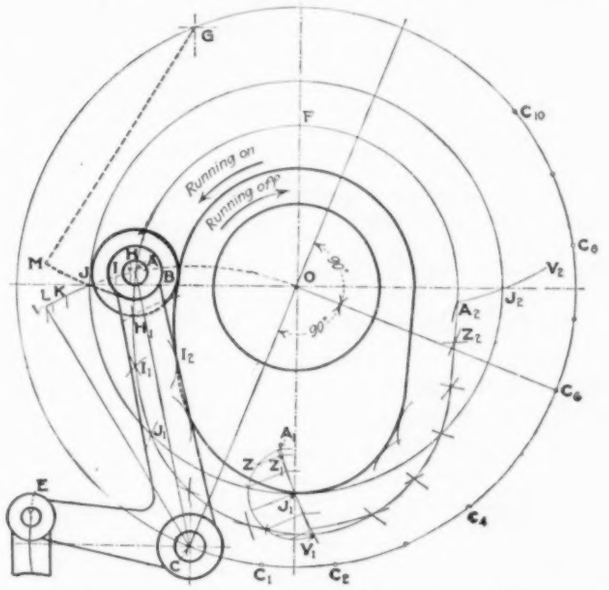


FIG. 46. PROBLEM 9, CAM WITH SWINGING FOLLOWER ARM, ROLLER CONTACT—SWINGING ARC, CONTINUED, PASSES TROUGH CENTER OF CAM

Problem 8. Required a radial periphery cam to operate a roller follower where the follower arm swings about a pivot and where the two extreme positions of the center of the roller lie on a radial line. The chord of the swinging arc of the roller center is to be 4 units and the length of the follower arm 8 units. The follower arm to swing: (a) Out full distance in 90 deg. on parabola curve; (b) in full distance in 90 deg. on crank curve; (c) and to remain at rest for 180 degrees.

A different method of construction from any thus far employed is used in problems of this kind because it gives the simplest and most accurate layout for the pitch surface. Briefly, the method to be used consists

in revolving the follower arm through the 360 deg. around the cam while the cam remains stationary, and drawing the follower in a number of its phases while on the way around. One of the phases is represented in full by the dash line $C_2 Y_2 Y_3$, Fig. 45.

The angle which causes pressure against the follower bearings is also different in this form of cam from any of the others. An inspection of Fig. 45 will show that in general the normal line of pressure AV at A between the cam surface and the roller is not at right angles to the position of the follower arm, and therefore that the resultant total pressure has a component along the arm, tending to place it in compression and throwing a corresponding pressure on the follower bearing at C.

The pressure angle at A is shown by $-a$, the minus sign indicating compression in the swinging arm. When K_1 is at K the pressure angle will be $+c$, the plus sign indicating tension in the follower arm. A disadvantage of the sign changing from + to —, etc., is that as soon as the bearings wear there will be noise at that point.

The detail for the construction of problem 8 is taken up by computing the diameter of the pitch circle first, as in previous problems. This computation, however, serves only as a guide, for the assigned pressure angle will be both increased and decreased by amounts depending on the radius of the follower arm and the characteristics of the base curve which is used. For computing the pitch circle then, an assigned pressure angle factor for 30 deg. will be assumed in the expectation that the final maximum angle will not exceed 40 deg. From the formula $d = 114.6 \frac{h \times f}{b}$ in which h equals stroke of follower, f equals pressure angle factor, and b equals number of degrees of turn of cam allotted for the stroke, as explained in Article 1, $d = 114.6 \frac{4 \times 3.46}{90}$ $= 17.62$ for the parabola curve; and $d = 114.6 \frac{4 \times 2.72}{90}$ $= 13.86$ for the crank-curve assignment. Since the larger value thus found must be used the radius of the pitch circle is found to be 8.81 units.

TABLE OF CAM FACTORS

Name of Base Curve	Maximum Pressure Angle and Values of f 20°	30°	40°	50°	60°
Straight line	2.75	1.73	1.19	0.84	0.58
Straight-line combination *	3.10	2.27	1.92	1.77	1.73
Crank curve	4.32	2.72	1.87	1.32	0.91
Parabola	5.50	3.46	2.38	1.68	1.15
Elliptical curve †	6.25	3.95	2.75	1.95	1.35

* For case where easing off radius equals follower's motion
† For case where ratio of horizontal to vertical axes of ellipse is 7 to 4.

Having determined the radius OD, Fig. 45, for the pitch circle the given chord of 4 units is laid off with equal parts on each side of D, thus locating the ends of the swinging arc AV on the radial line OD as required. With A and V as centers and a radius of 8 units for the length of the follower arm, strike arcs which will intersect at C and give the fixed center for the follower arm. The arc AV showing the path of the center of the follower roller is now drawn.

Points on the pitch surface AV_1A_2F, Fig. 45, are found in brief by revolving the arm CA around O, swinging it a proper amount on its center C as it revolves. In detail this is accomplished by laying off the arc CC_6 equal to 90 deg., and dividing it into a number of equal parts, say six. Divide the arc AJ into three unequal parts, as at H and I, for the parabola curve. Lay off the points L and K in the same way. Then with CA as a radius and with C_1, C_2 . . . as centers draw the arcs passing through H_1 I_1. . . . Again, with O as a center, swing arcs through H, I . . . until they meet the arcs already constructed. The intersections of these arcs, as at H_1, I_1, J_1, . . . will be the points on the desired pitch surface AV_1. The determination of the pitch surface for the crank curve is found by laying off the second 90-deg. assignment from C_6 to C_{12} and dividing it into six parts. The arc A_1 V_1 is divided by projecting the points U, W . . . of the crank circle to the points U_1, W_1, on the arc. The constructions for the points U_2 W_2 . . . are the same as for the previous part of the pitch surface as described above.

Cam with Swinging Follower Arm, Roller Contact—Swinging Arc, Continued, Passes Through Center of Cam

Problem 9. Required a radial periphery cam to operate a roller follower where the follower arm swings about a pivot, and where the center of the follower roller moves on an arc which, continued, passes through the center of the cam. The chord of the swinging arc of the roller center is 4 units and the length of the follower arm 10 units. The follower arm to swing: (a) Out full distance in 90 deg. on parabola curve, (b) in full distance in 90 deg. on crank curve; (c) to remain at rest for 180 degrees.

The procedure for this problem is the same as for problem 8 in all respects except the layout of the arc of swing for the center of the follower roller. The pitch circle is drawn with radius OJ, Fig. 46.

With the center of the cam O and the pitch point J as centers draw arcs which intersect at C, the radius being equal to the length of the follower arm. Lay off JA and JV equal to each other and so that a chord drawn from A to V equals the four units assigned. A bent rocker ACE is introduced in Fig. 46 simply to change the direction of motion.

Effect of Location of Swinging Follower Arm Relatively to the Cam

When the swinging follower arm is mounted so that the extremities of the arc of travel of roller center are on a radial line, as in problem 8, the pressure angles on the out and in strokes will be the same, but in reverse order. When the follower roller center moves on an arc which, continued, passes through the center of the cam, as in problem 9, the pressure angle will be larger, on the average, on the one stroke than on the other. Consequently the type shown in problem 8 would have an advantage where equal amounts of work were to be done on both strokes, and the type shown in problem 9 would be of advantage where heavy work was to be done on one stroke only. Either the out or in stroke may be selected for heavy work, according to the position taken for the center C or G of the swinging arm, Fig. 46, the direction of turning of the cam being the same. In many cases the type shown in problem 9 allows the pressure angle to be maintained on one of the strokes so that there is pressure in only one direction on the shaft C. Cams operate smoother when "running off" than when "running on." A cam is said to be running off when the point of contact on the working surface of the cam is moving away from the fixed center of the swinging follower arm. A cam of the type

illustrated in problem 8 will have an axis of symmetry where the same data are assigned for the out and in stroke, whereas the cam illustrated in problem 9 will be quite unsymmetrical for same data.

Positive-drive face cams—The pitch surfaces for face cams are laid out in exactly the same manner as pitch surfaces for radial periphery cams regardless of whether the pitch point of the follower moves in a straight or curved path. The only additional feature of construction is that a working surface is drawn to touch each side of the roller.

Cam with Swinging Follower Arm, Sliding Surface Contact

Problem 10. Required a radial periphery cam to operate a swinging arm having a construction radius of 9 units. Sliding surface contact between cam and follower. The arm to: (a) Swing up 4 units on the crank curve base while the cam turns 120 deg.; (b) swing down 4 units on the crank-curve base while the cam turns 120 deg.; (c) remain at rest for 120 degrees.

This type of cam and follower is illustrated in Fig. 47. The line of pressure between cam and follower is

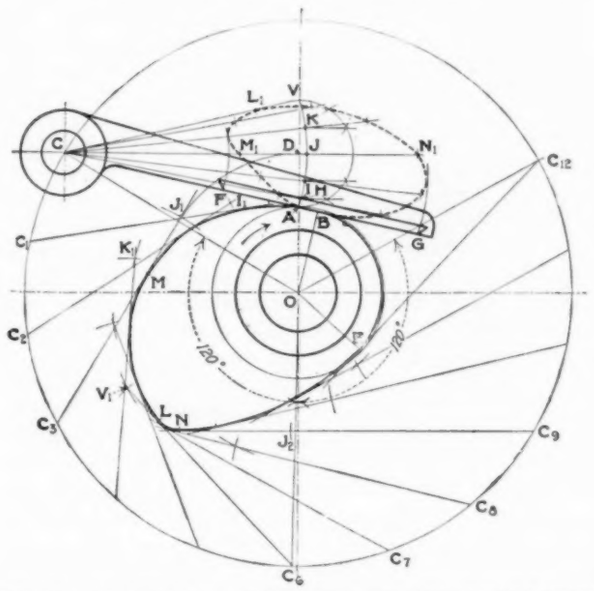


FIG. 47. PROBLEM 10, CAM WITH SWINGING FOLLOWER ARM, SLIDING CONTACT

always normal to the follower surface and consequently there is no component of pressure in the bearing at C due to pressure angle. This cam is therefore independent of a pitch circle based on pressure angle, and the pitch circle may be taken any size. Where one has no special guide in assuming a starting size for the cam, the usual computation for pitch circle for a 30-deg. pressure angle may give good average results. According to this the pitch radius OD will be

$$4 \times 2.72 \times 3 \times \frac{1}{3.14} \times \frac{1}{2} = 5.2 \textit{ units}$$

AV equals 4 units and AC equals 9 units. The point A is taken for construction purposes as a point on the follower arm where the angular velocity of the arm is measured. It will be at the points $H, I, J, \ldots$ on the arc AV at the end of equal succeeding intervals of time.

The method of constructing the cam in this problem is identical with the method used in problem 8 in so far as the follower arm is swung around the cam and its position with respect to the cam center at equal time intervals is drawn. The departure from the method of problem 8 consists in drawing the cam outline as an envelope to these follower-arm positions. For example, in Fig. 47, at the end of the third time interval the pivot C has been revolved to C_3 and the point A of the follower arm has moved out to J_3. The point J_3 is found at the intersection of two arcs, one obtained with CA as a radius and C_3 as a center and the other with OJ as a radius and O as a center.

When a number of positions of the follower arm, such as C_3J_3, have been obtained, the smoothest possible curve is drawn tangent successively to each of them, and this curve is the working surface of the cam. This curve is tangent to C_3J_3 at M, and if the distance C_3M is laid off at CM_1 the point M_1 will be the actual point of tangency between the cam surface and follower arm when the arm is halfway through its swing, or when A is at J. Similarly when C_9 is at C the point of tangency between cam and follower arm will be at N_1.

The locus of the point of contact between the cam and follower relatively to the frame of the machine is shown by the dash closed curve through M_1 and N_1. By drawing arcs tangent at the extremities of this dash curve, using C as a center in both cases, the points F and G on the follower surface are obtained and the distance FG will be the part of the follower exposed to

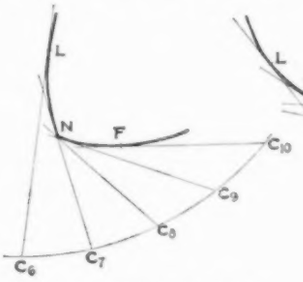


FIG. 48. LIMITING CASE FOR STRAIGHTEDGE FOLLOWER WITH SLIDING CONTACT

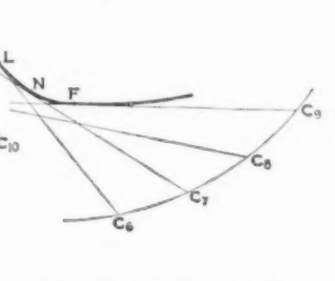


FIG. 49. IMPOSSIBLE CASE FOR STRAIGHTEDGE FOLLOWER WITH SLIDING CONTACT

wear from the rubbing of the cam. This part of the follower arm may be designed with a shoe, as indicated, which may be replaced when worn.

It should be specially noted that the shortest radius of the cam is not OA, but OB. The point B is found by drawing a perpendicular to CG through O.

The very decided lack of symmetry should also be noted, the curve BL being used to lift the arm, and the curve LE to lower the arm, the swinging velocities of the arm being the same in both directions.

Data Limited for Followers with Sliding Surface Contact

The data for this type of cam construction are extremely limited when the swinging velocity of the arm is assigned. The limitations are that the working surface of the cam must be drawn tangent to *every* construction line *in succession*, and that it must be convex externally at all points. In most arbitrary assignments the construction line through C_9, for example, Fig. 47, would intersect the line through C_1 before it cut the line through C_2. In this case it would be impossible to draw a smooth

working curve tangent, successively, to the lines through C_4, C_5 *and* C_6. This is illustrated more clearly in Fig. 49 and will be more evident after the limiting case is described.

The limiting case for flat surface followers with sliding contact occurs where three or more of the construction lines meet in a point at N in Fig. 48. In this case the working surface of the cam would have a sharp edge. In this type of cam it is necessary to use more construction lines than in other types because it is possible to have the construction lines so far apart that such a case as is shown in Fig. 49 might not evidence itself at all. For example, if the distance C_6C_7 were the unit space for construction lines, instead of C_6C_5, the smooth convex curve FNL could be drawn tangent to lines through C_4, C_7 . . . without the error showing itself.

If it is required of this cam only that it shall swing a follower arm through a given angle in a given time, without regard to the intermediate velocities of the arm, it may be as widely used as any other type of cam. In this case only the innermost and outermost positions of the arm would be drawn, as at CA, C_6V_1, and $C_{12}E$, Fig. 47, and a smooth convex curve drawn tangent to these lines. Such construction, however, might give an irregular or jerky motion to the follower. Whether it did or not could be readily determined by laying off a number of equal divisions, as at C_1, C_2 . . . C_{12}, drawing lines, such as C_3J_3, tangent to the assumed smooth convex working surface, and revolving C_3J_3 back to CJ. After doing this with other construction lines a series of points, such as H, I, J . . . would be determined and the spaces between them would represent the distances traveled by A on the follower arm during successive equal intervals of time.

Toe and Wiper Cams

In this form of cam construction the cam, or wiper, oscillates or swings back and forth through an angle of 120 deg. or less, instead of rotating continuously the full 360 deg. as it does in all cams thus far considered. The follower, or toe, is usually a narrow, flat strip resting on the curved periphery of the cam and moving straight up and down. The form of the cam for a toe follower is found in the same general manner as for a cam with a mushroom disk follower, as described in Article IV, and therefore its analysis and construction need not be given here. In a later installment this type of cam will be considered in connection with specific follower and sliding velocities.

Know What the Other Fellow Is Doing

By John R. Godfrey

It's a mighty good plan to know the good points of the other fellow's machine as well as your own. In fact, it is an equally good plan to know the weak points of your own machine as well as of his, although it may not be advisable to enlarge on this point when it comes to enthusing the salesmen at the annual get-together, in which you sell them your product.

We may have a perfectly legitimate reason for building our machine as we do, but we quite frequently find that it pays to know the other fellow's ideas on the same subject, and there seems to be no better way of learning this than to have one of his machines where we can look it over and find out its good points as well as its disadvantages. Perhaps one of the best examples of this is in the automobile field, where even the chief boosters of this particular game are advocating the importation of a few thousand foreign machines to act as a sort of yeast to the industry in this country.

We are at the point where everyone admits without argument and without asking proof, that the American motor car and motor truck industry is supreme when we consider quantity production. Our Fords and Lelands and Whites and Rikers and a host of others have designed cars and trucks and perfected manufacturing organization so that we could produce them at a lower price than any other country. But the very fact that we have had the American market by the tail and that no one else had even a fraction of a look-in, may have had its drawbacks. We have effectually kept out cars and trucks of other countries while at the same time we have induced them to buy and use thousands of our own. But in keeping out these foreign cars we have also kept out many of their ideas, and as the secret department of any shop is usually the most inefficient, this has prevented us from absorbing some mighty good ideas both in design and construction.

The Buzz-Wagon of Early Days

In the early days of the buzz wagon, gasoline was very cheap in this country, so that fuel consumption hardly needed to be considered. After the first spasm in which we practically fastened a small motor into a buggy, we were bitten with the desire for high-speed and great hill-climbing ability. As a result we have the present high-powered car in which we all boast, and not always truthfully, about being able to take every hill on high. The increasing cost of gasoline and the decreasing miles per gallon are putting us into something of the same condition as our friends in England and France, and it is quite probable that we could study some of their cars to advantage.

Instead of loading down the car with a motor with sufficient power to save us the necessity of shifting gears except in extreme cases, we may well consider the adoption of a lower-powered motor which will probably handle 75 per cent. of our driving in high gear and perhaps change our standards of pride and respectability. These may even yet be so changed that to own a car in which we occasionally shift into second speed will not be a mark of utter depravity.

Smaller motors mean more than might appear at first thought. They mean lighter cars and lower tire expense, both of which mean that we will pay less tribute to the oil kings and the emperors of the rubber industry. Such a change ought to reduce the wear and tear on the highways, unless this is more than offset by the ever-increasing traffic of motor trucks.

It is also barely possible that we might study comfort rather than style to advantage, and this will probably come when we get to the point where we will consider the family automobile in the same way as we did the old horse and the family phaëton.

It is more than probable that a similar study of various machine tools might show us that for some classes of work we have gone too far in high-powered machines. The importation of a few of the best machine tools from the other side might be advantageous in several ways and we must not forget that our greatest danger is in being too well satisfied with what we have already accomplished.

US
ARMY ORDNANCE NEWS

Hydraulically Operated Shell Machines

By P. B. COCHRANE

While the shell-making machines here illustrated finished their particular jobs with the signing of the armistice the principle underlying their design might well be applied to machines of a more peaceful type. The simplicity of arrangements and the rugged character of the parts are worthy of note; also the comparative novelty of the hydraulic control of shifts and feeds.

THE special 6-in. shell machines shown in the illustrations were designed and built by the Symington Chicago Corporation with their several moving parts actuated by hydraulic means on account of the simplicity, flexibility and general economical operation. In all machines the work is gripped by the standard design of pull-rod cylinder which revolves as a part of the spindle unit and receives hydraulic pressure through a special revolving distribution coupling. The spindles are of cast iron running in babbitted bearings, and each carries an oiling chain fed from a large well. The machines are motor driven through a worm and gear, the motor being connected by a belt to a clutch pulley on the worm-shaft. The clutch pulley is shifted by a 2-in. hydraulic cylinder and the belt tension is regulated by an idler-pulley unit. The control valves are the heavy cock type, and in most cases regulate the slide action by throttling, thus making a variable-speed mechanism which reduces the operating time. Each

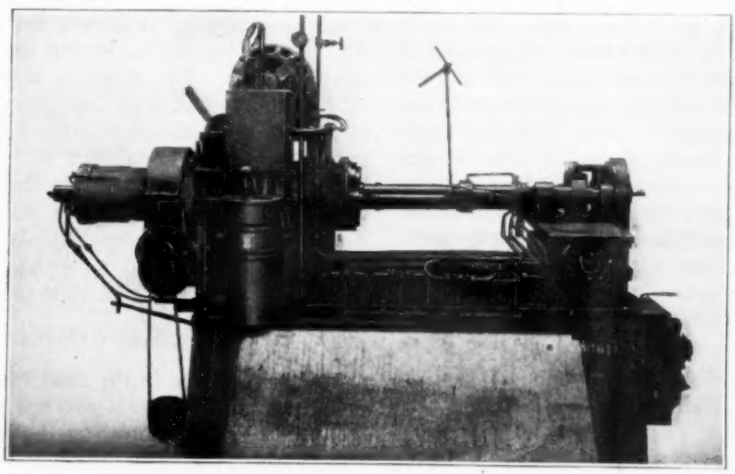


FIG. 1. CENTERING MACHINE

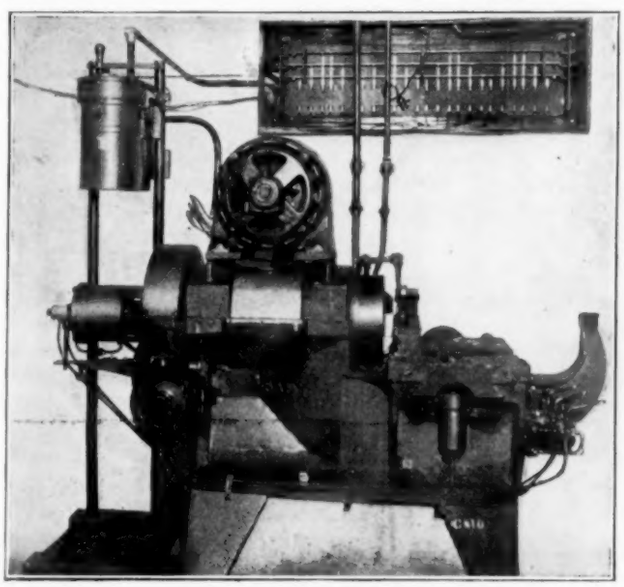


FIG. 2. CUT-OFF MACHINE

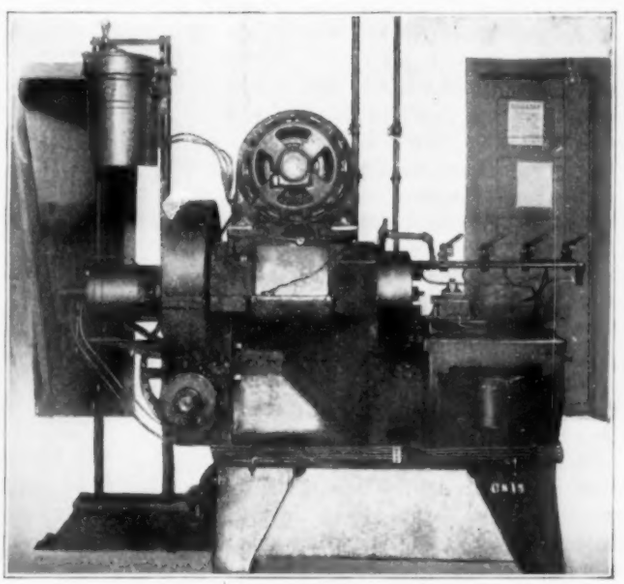


FIG. 5. ROUGH-FACE BASE MACHINE

ARMY ORDNANCE NEWS

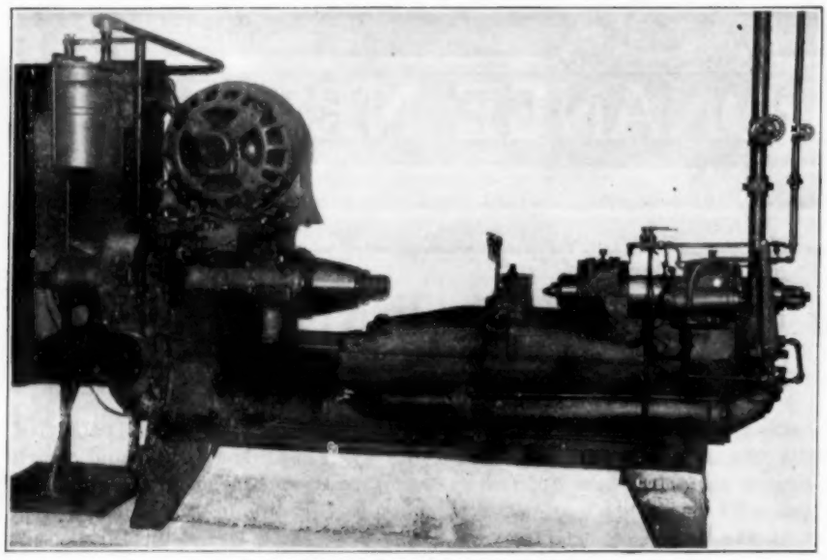


FIG. 3. ROUGH-CUTTING LATHE

machine is equipped with a hoisting davit and special shell sling so that the operator has no heavy lifting to do.

Thirteen of the operations in the manufacture of the shell were taken and machines of four different types designed to perform them as follows: Type A for end-facing, cut-off and boring the nose; type B for turning; type C for profile boring and reaming, and type D for centering, cutting band groove and turning copper band. Water pressure of 200 lb. per square inch is used for all operations except cutting the base and band grooves, and is generally carried through ½-in. pipe.

Machine Used for First Operation

Fig. 2 shows the type A cut-off machine, which performs the first operation. The forging is held in a hydraulically operated three-jaw chuck fixed in a 12-in. diameter spindle driven by a 10-hp. motor. Two cut-off tools are carried in separate slides which are operated simultaneously by a 7½-in. cylinder just visible over the top of the slide. The heavy bracket at the right is to mount a work stop not shown.

The type D machine in Fig. 1, as set up for the centering operation, carries a spindle holding a mild-steel arbor with two sets of three-point support dogs. The tool slide is shifted transversely by a 3-in. cylinder at the back and carries another 3-in. cylinder to operate the centering-drill advance lever. The drill is belt driven at high speed by a 1-hp. motor.

In Fig. 3 the type B rough-turn lathe carries an 8-in. cast-iron spindle driven by a 35-hp. motor. In the spindle is an expanding arbor operated by the cylinder seen at the extreme left, the piston in which exerts a pull of 8000 lb. The tail spindle can be moved 6 in. by the two cylinders coupled to the yoke at the extreme right. The carriage mounts heavy tools at front and rear and is moved by the long hydraulic units shown at the side.

Finish-Turning

The spindle design of the type C rough-point tool machine in Fig. 4 is similar to that shown in Fig. 2. The heavy carriage is advanced by units similar to those in Fig. 3 and carries a stout boring bar mounted on a cross-slide, the motion of which is controlled by a cam and roller device to get the desired profile on the inner surface of the shell.

Inside finish-turning is done on the type C lathe shown in Fig. 6. It differs from the machine in Fig. 4 in having two 4½-in. boring bars which go to position against stops. The carriage is moved longitudinally as in Figs. 3 and 4 and transversely by the 4 x 16-in. cylinder shown at the right. The arrangement of control valves is well shown in this figure. The first valve from the left controls the hoisting davit, which has been removed from this machine but is shown in Fig. 4; the second valve controls the spindle chuck; the third the driving clutch, which is behind the spindle, and the fourth the cross-slide cylinder.

Orifice Valve Governs the Speed

The small valve in the feed line farthest to the right is an orifice valve which governs the speed of the cutting feed and prevents crowding the machine beyond reasonable limits. The three-way valve takes pressure through the orifice valve and controls the feed mechanism.

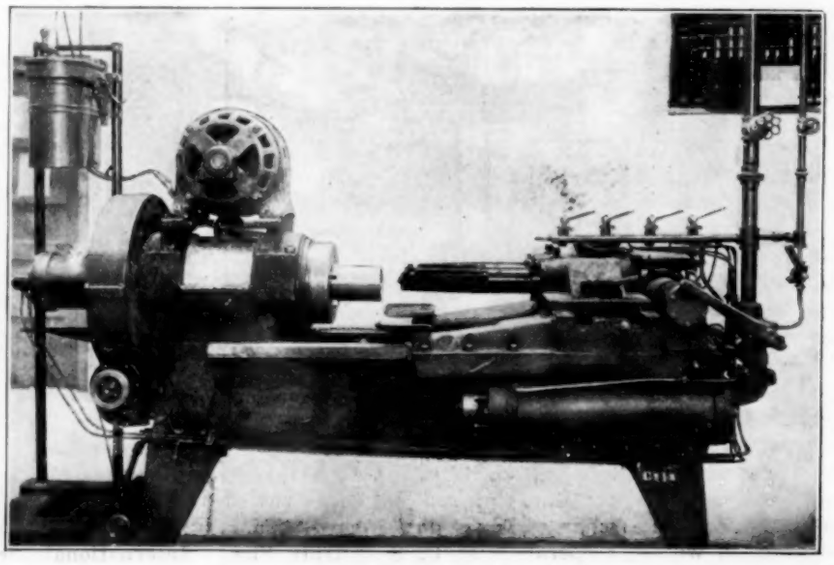


FIG. 6. INSIDE FINISH MACHINE

ARMY ORDNANCE NEWS

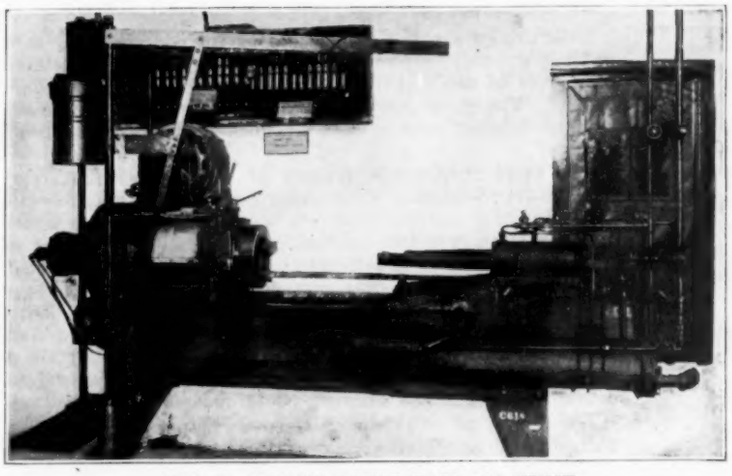


FIG. 4. ROUGH POINT TOOL MACHINE

Fig. 5 shows the rough-face base machine, type A, which is essentially the same as the one shown in Fig. 2 except that a single slide and tool only are used instead of double ones.

PERSONALS

Lieut.-Col. William E. Marble, who was commissioned Captain in October, 1917 and twice promoted, was discharged on his return to America from overseas. Col. Marble was with the Army of Occupation while abroad. His home address is Greenwich, Conn., and he was formerly with the R. G. Corset Co., of New York City.

* * *

Maj. Louis A. Pierrong, who was commissioned Captain in November, 1917, was discharged on his return from overseas. His duties have had to do with the purchase of hardware, small tools and the like. His home address is Euclid Ave. and 105th St., Cleveland, Ohio. He was formerly engaged in dealing in iron and steel products.

* * *

Maj. Andrew C. Vauclain, whose address is 2416 North 54th St., Philadelphia, Penn., has been discharged. Major Vauclain was commissioned in December, 1917 and served in the Inspection Division. Before being commissioned he was employed by the Baldwin Locomotive Works.

* * *

Maj. Wheeler Lord, who was commissioned in November, 1917, and served as Army Inspector of Ordnance at the Midvale Plant, has returned to civil life. Major Lord's home address is 5015 McKean Ave., Philadelphia, Penn. He was formerly engaged in the iron and steel business in that city, and is a graduate of Lehigh University.

* * *

Capt. Wm. Thomas Alliger, 15 Lodees Land, Cynwyd, Penn., has been discharged. His duties have been in connection with the operation of U. S. Nitrate Plant No. 2. He is a graduate of the University of Michigan, and in civil life was chemical and mechanical engineer for Harrison Safety Boiler Works, Philadelphia, Penn.

* * *

Capt. Lewis E. Tifft, whose home address is 4 Ridgewood Terrace, Springfield, Mass., was discharged on his return from overseas. Capt. Tifft was on duty in both France and England in the Finance Section. He attended Williams College and was formerly a member of Tifft Brothers, investment securities, Springfield, Mass. He was commissioned in August, 1917.

* * *

Maj. Reamy E. Field, recently discharged, has been on Claims Board work since the armistice was signed. Major Field is a graduate of the University of Lebanon. His home address is 3436 Vista Ave., Cincinnati, Ohio. He was formerly in the brokerage business.

* * *

Capt. Wm. H. Richard, 24 Fruit St., New Haven, Conn., has been discharged. Captain Richard's service has had to do with small-arms inspection and repair. He was superintendent of the Storage Division and Ordnance Property Officer at Augusta Arsenal. In civil life he was rifle and ammunition tester and demonstrator for Winchester Repeating Arms Co., New Haven, Conn.

* * *

Maj. Rupert L. Penney, who was appointed Captain in August, 1917, and who has been in charge of Armory Shops, and especially on installation of new heat-treatment equipment, has returned to civil life. He is a graduate of the Stevens Institute of Technology and before entering the service was a Testing Engineer with the Winchester Repeating Arms Co., New Haven, Conn. His permanent address is 126 Willard St., New Haven. Conn.

* * *

Capt. Louis I. Reichner, who has been on duty in the Civilian Personnel Section, has been discharged. He is a graduate of the University of Pennsylvania and Princeton. Previous to entering the service, Captain Reichner was a lawyer with the Fidelity Trust Co., Philadelphia. His permanent address is 1709 Rittenhouse St., Philadelphia, Penn.

* * *

Capt. Arthur P. Pain, who was commissioned First Lieutenant in August, 1917 and who has been on duty at the Savannah Proving Ground, has returned to civil life. He is a graduate of Amherst College and in civil life was a designer of automatic machinery. His permanent address is 369 Washington Ave., Brooklyn, N. Y.

* * *

First Lieut. Warren J. Keyes who was appointed Second Lieutenant in November, 1917, was discharged on his return from France recently. His duties have been with the Requirements Ammunition Division. He is a graduate of Yale and Harvard and is an accountant. On his return to civil life he is to be with the American International Corp., New York City. His home address is 723 South 6th St., Terre Haute, Indiana.

Export of Industrial Products*

BY EDWARD PRIZER
President Vacuum Oil Co.

The story of the nations that have succeeded each other in preëminence has been the story of enterprise in external trade. With the decline of foreign commerce decay sets in. The Phoenicians, the first great traders, lost their power when they lost their trade; Venice, mistress of the then known seas, succumbed to the enterprise of her rivals; Portugal had her day of power when she reached India by sea; Spain broke down her strength when she expelled the industrious Moors, and the aggressive Flemish hand-workers of Northern Europe continued their prosperity only so long as they maintained their external commerce. Of the great nations existing during that remarkable era of trade and expansion at the time Columbus discovered America, England alone survives as a great power.

THE United States, during the early years of its history, was too deeply engrossed in the vast opportunities for development at home to give serious consideration to overseas trade. At the outbreak of the Civil War some real beginnings had been made, and our glorious fleets of clipper ships were becoming the carriers of ocean bound commerce, and our flag floated in all the great harbors of the world; but the ravages of four years of war on our own soil wasted our wealth and dulled our energies; and in the healing of our wounds we lost for a time our vision of international opportunities.

During the progress of the world war our exports of industrial products have been measured only by our capacity to produce and steamship space to transport. This was not the case before the war, and is not the case now; and we are face to face with a vast expansion in our manufacturing capacity which must be consigned to idleness and rust unless we expand our markets to absorb our potential output.

The export of raw or semi-finished articles unquestionably adds to national wealth but gives little aid to industry. We must export cotton in fabrics and not in the bale; iron and steel in machinery and implements; leather in shoes and other finished articles; use our coal under our own factory boilers; and in every way multiply the overseas movement of products of hand and brain which our recognized manufacturing and inventive skill, unequalled by any other country of the world, so eminently fit us to produce.

Accurate Knowledge of Foreign Markets

We are largely a provincial and insular people. Our vast expanse of territory and the great seas stretching between us and the outside world, have shut off contact on the part of the great body of our citizens with foreign peoples.

There is danger therefore that we may visualize the peoples of the old world in terms of the new. Efforts for overseas trade based on lack of first-hand and accurate knowledge of foreign markets will be wasteful, ineffective and disappointing.

At home we have a flexible and intelligent market. The great body of buyers are educated and alert. New things are readily introduced, and improvements or betterments meet with a quick response.

In the great markets abroad, however, different conditions exist. Behind the great buying public, centuries of custom and prejudice exist. National habits are fixed and more or less unchangeable.

New things are not impossible of introduction and sale in time, but an effort to change established habits as relates to staples of use and demand is an almost hopeless undertaking. The great body of consumers in many of the markets of largest promise are uneducated, and resentful of change.

The most remarkable feature of modern-day industrial development was that of Germany before she staked her all on a war of world conquest and went down in ruin. While there was much in her methods and practices we cannot in self-respect follow, it is none the less true that her great success was not accidental, but based on underlying fundamentals which we must adopt to insure a like success. With painstaking thoroughness the Germans studied the foreign markets they designed to invade, and definitely ascertained in advance what would find ready sale. They catered to established needs and existing preferences.

I was told of a group of German industries, organized somewhat as our Webb-Pomerene law now permits of, combining and employing a small body of experts, who were sent to South America simply to study and report on existing trade opportunities. For two years these experts made a painstaking survey, reporting fully to their employers. Every detail was examined and analyzed. Where necessary, samples were sent back home. The question of credits, terms of sale, and like essential matters were carefully gone into. They even discovered what others hitherto had not known, that the colors and designs of certain fabrics worn by a considerable group of people were semi-religious in significance, and hence nothing else would be saleable irrespective of improvement in quality or cheapness in price. It is needless to state that when this combination of German manufacturers moved on the markets they thus studied, their progress was invincible.

The Germans also developed the fact that there was a material demand for machinery in interior places remote from railways. So they made their machines in sections small enough to be transported on mule back. On arriving at destination, these were bolted together and ready for quick use. American machines designed for similar service never got beyond the seaboard, for while more efficient than the German make, they were in too large units to be handled.

Choice of Representatives

The personal equation is an essential factor of commercial success. In competition the agreeable and acceptable representative generally wins against an opponent not equally gifted. But representatives of American concerns for foreign fields should be chosen with great care, and rigidly trained for their required duties. They should be those desirous only of establishing a more or less permanent foreign career; if going to a foreign-language country, they should be able to speak the tongue or quickly to acquire it.

Business is generally done abroad in a certain leisurely fashion sometimes irritating to the American hustler; important transactions are frequently originated or completed in café or club. Too great haste or undue immediate pressure frequently defeats itself.

There is also more or less undercurrent of suspicion as to so-called "Yankee smartness." Great tact, patience, straightforward action, unquestioned integrity, and unfailing courtesy are fundamentals. After all, it is character that tells. Confidence when fully gained counts for more in permanence of commercial relations abroad than at home, for as a general rule the foreign buyer is slow to change and adheres with much tenacity to those firms or individuals which have won his full trust.

The American exporter will find foreign fields already occupied with trained and capable representatives from other countries, and it will be idle for him to send abroad as contestants any other than our best.

I do not think it an unfair statement that for some years

*From an address delivered at the Sixth National Foreign Trade Convention, Chicago, Ill., Apr. 24, 1919.

prior to the war the attitude of our lawmakers toward industry was one of ill-disguised hostility.

There had been an era of muck-raking, in which popular writers found a ready sale of mis-statements, half-truths and direct abuse. Our politicians saw opportunity to curry popular favor by joining in the hue and cry against successful business enterprise. The greater the measure of success the louder the abuse. The successful business man did not know whether to be proud or ashamed. Mr. Bryan, our great American economist, proposed to measure the extent of criminality by the per cent. of the total business a firm or individual secured.

The Department of Justice announced at the entrance of this country into the war that all prosecutions under the anti-trust act had been postponed, leaving the plain inference that then existing combinations must function unhampered if the war was to be won.

This same Department recently announced in the public press that the combinations in all essential industries forced by the Government as war measures would be prosecuted if continued after the declaration of peace. Are the underlying principles of economics so unstable that they shift as between war times and peace?

The Webb-Pomerene bill legalizes combinations when operative beyond the shore line. It, therefore, recognizes the principle of combination. Could not this law be so broadened as to permit such consolidations at home as are economically sound and fundamentally proper and just, and which would result in great savings in cost of manufacture as well as distribution, so that the American producer would not be forced to enter the foreign field with a heavy initial handicap?

England has never been afraid that any of her industries would grow too large in scope or operation. Newspaper dispatches advise she already is planning to enter industry as a governmental enterprise, and to bring about consolidations of such magnitude as to be fraught with great danger to American industries of like character. Is it wise practice to limit our industries to small and uneconomical units by preventing by law just combinations of enterprise, capital and skill?

Congress itself needs a new vision. In England, leaders of industry are made peers of the realm, boards of trade have legislative functions, and foreign commercial operations are carefully watched over and safeguarded. I believe it is the practice of the French government, when any of her citizens are seeking foreign concessions, to send a governmental commissioner with them to make sure every legal right is fully protected.

Before the war, however, when our relations with Mexico were under discussion in Congress, one of the members asserted that American investors, with all the opportunities that existed at home, had no justification for going abroad, and if they did so, the risk should be theirs alone, without expectation of assistance or support from their government. Such an attitude can hardly be regarded as encouraging to foreign-trade enterprises.

Legislation by Foreign Governments

There are evidences that certain foreign governments are now considering the adoption of legislation which may be highly detrimental to American concerns already established and operating within their boundaries, or to others that may later desire to do so. Our own Congress should give serious heed to this tendency and demand that American industry and capital shall be granted the same rights abroad as are granted to foreigners in our own markets. Some of the measures already being discussed for legislative enactment abroad by governments unchanged in form by the war are fraught with positive danger to American export trade.

Our consular service should be safeguarded from the blighting shadow of political control or preference, and there should run through it to the remotest sections of the world the certainty that capability is prized and that merit will be recognized and rewarded. It should be trained in business conditions and methods, and encouraged to be constantly alert to business opportunities for American industry. Periodical consular reports of a general character, while interesting and helpful, are not alone sufficient. There must be concreteness of information and directness of support.

A gentleman told me that at a certain South American port he found great difficulty in obtaining any really useful information to assist his sales effort; so almost in despair, he appealed to the German consul, who courteously aided him in his dilemma. He found this consul had prepared a complete card index of commercial conditions. It covered not only the usual statistics of imports, consumption, etc., but went into such intimate details as to the standing and credits of individual merchants, lines of products they already handled, or might be induced to carry. It was his practice to send to his government at home all this information which was available for the German exporter. What was being done by him at this port was doubtless being duplicated at hundreds of other centers of commercial opportunity.

Intelligent Control and Operation of Our Shipping

Nothing more fully illustrates our apathy toward foreign trade prior to the war than our national attitude concerning overseas shipping. We saw small countries like Holland, Denmark and Norway becoming great maritime powers; we saw Germany, throwing aside all restrictive legislation, constructing and operating a tonnage that was the marvel of modern times; we saw England, grim and determined, never ceasing her efforts to remain the mistress of the seas; we saw our own harbors congested with ships flying foreign flags.

And yet we were so unconcerned that we adopted new restrictive legislation more crippling than that previously in force so that our flag was fast disappearing altogether from the open seas in merchant service.

We have now embarked on a great national shipping adventure—and we are as yet mere novices at the game. It is not too strong a statement to make, that our national prosperity in export commerce will depend upon the wise and intelligent operation of our merchant marine. All other things being equal, the nation that controls shipping controls export trade.

Our vessels are being constructed at the maximum of cost, and export commerce cannot bear the load of charges necessary to yield a profitable return on the investment. Therefore, the charging off of the extreme costs to a normal basis must be a national burden assumed for the common good. Otherwise exports will languish. Already England has set the pace in reduction of rates, and other countries have large tonnage constructed at pre-war costs.

Uncertainty of Delivery Fatal to Export Sales

The movement of vessels as relates to trade routes must be worked out with great care. Nothing is more fatal to export sales than uncertainty as to delivery.

The Germans, with great foresight, after carefully considering trade possibilities, definitely assigned vessels for periodical sailings; and these ships sailed as advertised whether fully loaded or otherwise.

Nothing before the war and even now has been so harmful to our operations in South America as the uncertainty of transport of goods and mail. Regular sailings and quick movement alone will permit our securing the preëminence in the markets to the south of us, which our location and our facilities warrant.

While this address was being prepared I received a letter from our general manager for South America, written at Buenos Aires under date of Feb. 23 and requiring some six weeks to reach New York, which contains the statement that since Dec. 1 there had not been a single week at that port during which two British mail and passenger steamers had not arrived, this being quite outside of arrivals of purely British merchant vessels. Mails were being delivered from London under three weeks. Advertisements were appearing in all the leading Argentine papers in regard to British products, and the British government had officially informed the different South American governments that all their industries were normally working again and that orders placed for any kind of products would be supplied without delay either as to manufacture or time of receipt.

In contrast to this our general manager stated that the last passenger steamer which left Buenos Aires for New

York, sailed in October, and the last direct mail service was by a steamer leaving Feb. 2. Since then not a single passenger or direct mail boat had left Buenos Aires for New York, though one had been announced as possibly to sail at the end of March.

Make sure that every shipment that leaves this country is up to full standard of quality—the second lot in every respect as good as the first.

Fulfill every obligation with scrupulous fidelity, even though a bad bargain was made, in the carrying out of which material financial loss is unavoidable.

Go to any reasonable length to satisfactorily adjust a bonafide complaint, for a disgruntled buyer is a ruinous asset.

Pack shipments at least equal to European practice. There has been much legitimate complaint as to the flimsy character of American packing, resulting in goods frequently arriving at destination in deplorable condition.

Study the weights, measures and currency of foreign countries, and do not hesitate to use them when submitting offers, so the buyer will know his costs at point of receipt.

Print advertising literature and pamphlets of instruction in the language of the country where use is to be made. Do not make the mistake of thinking that English is a universal language, or that foreign buyers, when unfamiliar with it, will take the trouble to have it translated into their own tongue.

Give careful thought as to how exports are to be paid for. It cannot be done in coin. Our own Government had to establish large credits to our Allies to finance war purchases made here, to be liquidated later by imports of commodities. If we deliberately close our national doors to the products of other nations, we will close foreign doors to ourselves at the same time, as payment must be made in commodities of some character. England as a nation has learned to take foreign stocks and bonds, and a sharing interest in local enterprises, in payment of her exports. We, too, as a nation must learn to do the same if we are to expand our exports.

Dynamometer for Testing Twist Drills

By R. Poliakoff
Asst. Prof. of Mechanical Technology, Technical Institute, Moscow, Russia, Pro tempo., New York

The dynamometer described in this article was designed and built by the author for the purpose of testing drills in a lathe, with the view to finding the torque and thrust exerted by different drills under varying conditions of speed, feed, material, diameter, etc.

Fig. 1 shows the dynamometer mounted on the toolrest of the lathe. Fig. 2 gives a larger view of the dynamometer itself showing its general construction and parts.

The blank *A*, Fig. 1, in which the hole is to be drilled is fixed in the chuck of the lathe, and is rotated during the process of drilling while the drill, which is set in the dynamometer, is fed toward it. The torque set up

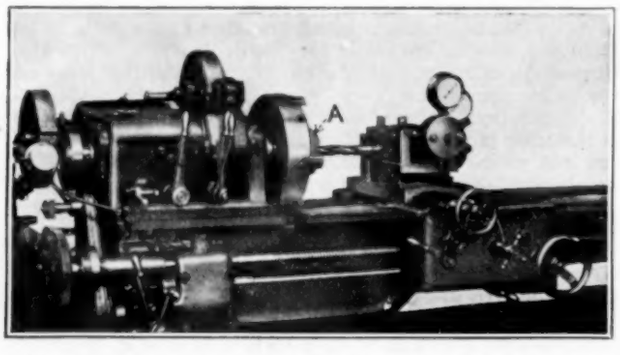


FIG. 1. TWIST-DRILL DYNAMOMETER MOUNTED ON THE LATHE

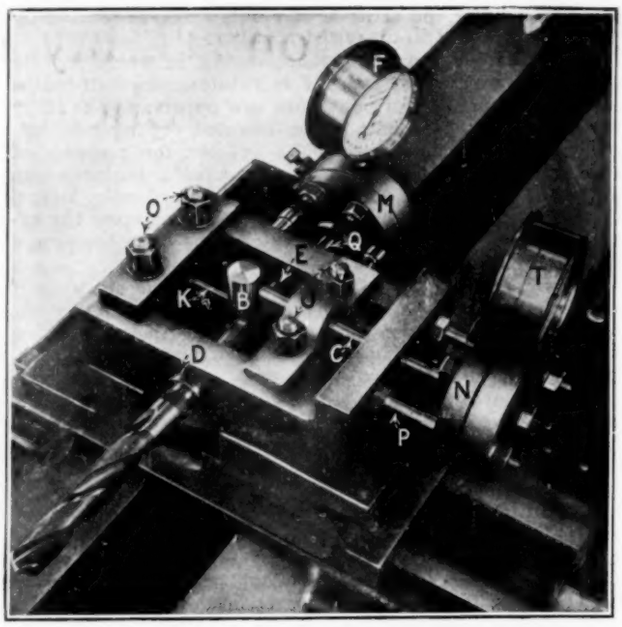


FIG. 2. CLOSE-UP VIEW OF THE TWIST-DRILL DYNAMOMETER

during the process of drilling is taken up by the crank *B*, Fig. 2, into the corresponding recess of which one of the tapered ends of the rod *C* is inserted. The other tapered end of the rod *C* enters a corresponding hole of the hydraulic support *N* connected with the pressure gage *T*. The support *N* has a brass plate or diaphragm inside against which the rod *C* presses. This pressure is transmitted through the brass plate to the fluid—which is distilled water or oil—in the support and through it to the gage *T*. The hand of the gage will therefore move in proportion to the pressure exerted on it by the rod *C* through the angular movement of the crank *B* rotating in its bearings *D* and *E* on account of the torque exerted by the drill.

The crankshaft is mounted in ball bearings at *D* and *E*. The rod *K* prevents the crank from falling back to the left and provides for adjustment of the crank in its central or zero position for which purpose it has a threaded end with two nuts on it. The bolts *O* are to attach the dynamometer to the toolrest of the lathe. The rods *P* serve to attach the hydraulic support *N* to the body of the dynamometer. The end of the crankshaft *B* has a tapered socket to take the shank of the drill.

This crankshaft moves longitudinally in its bearings on account of the thrust exerted on the drill as it is fed into the blank, and this thrust is transmitted through the rod *Q* into the hydraulic support *M* and through it to the pressure gage *F*, the hand of which moves in proportion to the thrust exerted.

The gages *T* and *F* can be ordinary gages as used for determining any fluid pressure and registering in pounds per square inch. If we know the area of the diaphragm we can easily calculate the total pressure in pounds. In the case of the gage *F*, this will give the amount of the thrust directly; in case of the gage *T* the thrust will have to be determined by the relation of the indicated pressure to the leverage of the crank in order to get the torque in inch-pounds. Naturally the gages have to be properly calibrated before the tests are made.

An Automatically Indexed Piercing and Shearing Tool

By L. L. DODDS

Sometimes the cost of an operation is more affected by what immediately follows than by the manner of performing the operation itself. Here is an illustrated description of an ingenious tool that was designed not so much to cut down the cost of that operation, though that was accomplished, as to straighten out and simplify subsequent handlings.

IN THE manufacture of safety Autolock switches the Krantz Manufacturing Co., Brooklyn, N. Y., has developed a laminated copper contact brush, which presents an interesting opportunity for tool development, as depicted in the illustrations. The brush, as shown in Fig. 1, is made up of 12 strips or leaves, punched from a copper ribbon $\frac{1}{2}$ in. wide and 0.010 in., thick. These leaves are all of the same length, but

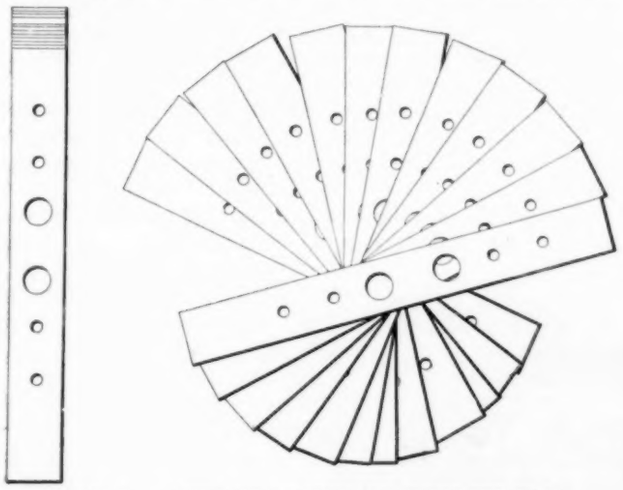


FIG. 1. A SET OF LEAVES OR BRUSHES FOR AUTOLOCK SWITCH

the location of the holes by which they are fastened together varies in steps of $\frac{1}{28}$ in., so that when riveted together each end of the completed brush presents a beveled appearance.

Before the development of the automatic indexing tool, which is the subject of this article, the method of producing the leaves with this variation was to cut from the copper ribbon a definite quantity of leaf No. 1 (the cutting and piercing being done at the same time), then adjust the relation of cutting blades to piercing punch and cut a similar quantity of leaf No. 2, continuing this until a sufficient number of all leaves were punched.

This rendered necessary the running through of comparatively large lots, and scrupulous care must be exercised to keep the different members from becoming mixed.

From the cutting tools the leaves passed to the sorting department, where they were stacked in racks, as shown in Fig. 2, from which they were taken by the assemblers in the first operation, which was known as bundling.

This was accomplished by placing one eacn of leaf No. 1 on each of the pins on the pin board shown before the operator in Fig. 2, following this with one each of No. 2, etc., until one of each leaf from Nos. 1 to 12 had been assembled. Each bundle was then removed from the pin board and wired together. From this point on the methods of handling have not been changed.

As the production of these brushes numbers many thousands in course of a year it was deemed advisable to devise better methods, and to this end I designed and built the tools here illustrated and described.

Fig. 3 gives a general view of the die in the press, while Fig. 4 shows a back view of the mechanism with the cover removed. Like letters refer to like parts in Figs. 3, 4 and 5. The end of the stock is fed through a guide *A*, Fig. 3, until it just clears the cut-off blade *B*, Figs. 3 and 4. The first stroke of the press squares the end of the ribbon and pierces the holes. The stock is then fed to stop *C* and held flat with the fingers of the left hand while the press is tripped. This completes leaf No. 1, which is then dropped over the two long rods, which are hung loosely upon the front of the bolster convenient to the left hand of the operator.

On each up stroke of the press the pull rod *D* which is attached to the gate raises the lever *E*, thereby causing a definite traverse movement of the piercing die,

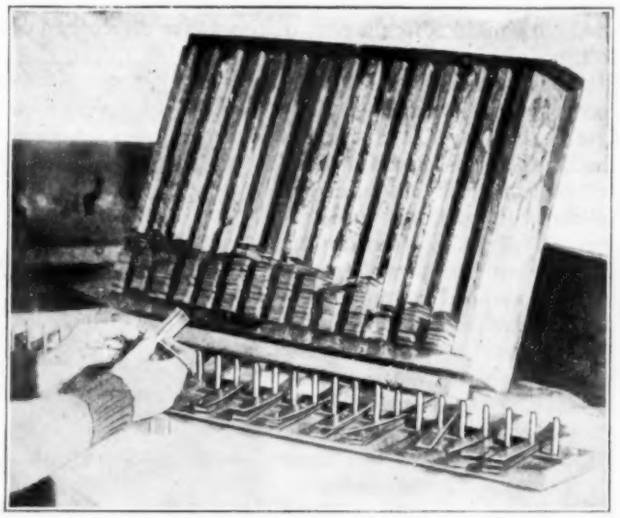


FIG. 2. PREVIOUS METHOD OF ASSEMBLING

which amounts to exactly $\frac{1}{28}$ in. This movement is transmitted to a train of gears *F* through a ratchet and pawl. On the shafts carrying the large gears are mounted heart-shaped cams *G*, Fig. 5, between which is the roller *H*.

The stud on which this roller turns is attached to the piercing tools, which with their punches form an independent unit arranged to slide freely but without shake in the dovetailed slide way *I*, Fig. 5.

The piercing tools are self-contained, being fitted with a stripper and with punch holder sliding on pillars, the punch holder resting on heavy coil springs so that it is not necessary to attach it to the press

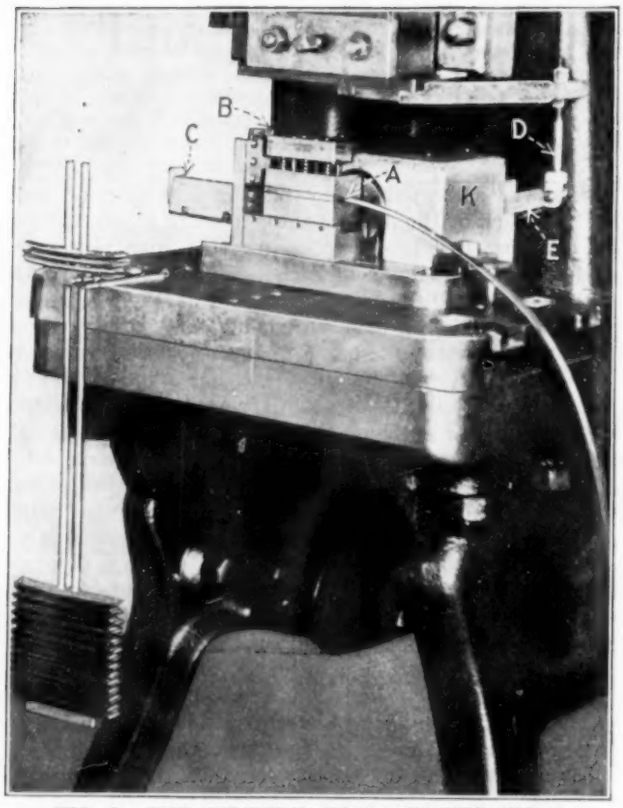


FIG. 3. THE INDEXING TOOLS IN THE PRESS

gate. The upper surface of the punch holder (which is of course hardened) is ground smooth, and a hardened-steel plate forms a part of the upper member, seen to the right in Fig. 5, which is attached to the gate. This construction leaves the tools free to be moved endwise by the cams as the punch holder, forced upward by its springs, follows the gate only just far enough for the punches to clear, when its upward movement is stopped by the shoulders of the pillars. The gate thus clears the punch holder before the ratchet comes into action and there is no resistance to the endwise movement of the tools so that the wear on the indexing mechanism is negligible. In order to eliminate side strain on the ratchet and pawl the lever *E* where it connects with the pull rod *D* is given a positive vertical motion; this is attained by slotting the lever where it bears on the fulcrum pin *J*, on which it slides. The action of the tool is as follows: Beginning by setting the tool to line in accordance with the instructions on the cover plate the operator proceeds to cut off the strips, or leaves, as he

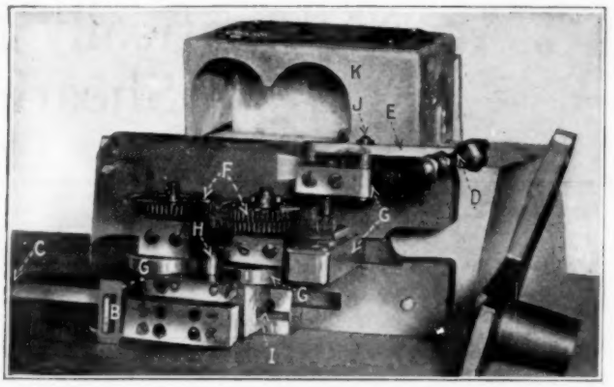


FIG. 5. TOP VIEW OF TOOLS

would with a stationary tool, the operation being as rapid and no more care being required.

With this device the piercing tools are moved forward by the ratchet and cams so that for 12 successive strokes of the press 12 leaves have been produced in which the holes have been moved progressively forward $2\frac{1}{8}$ in., making one set.

On the next 12 strokes the movement is repeated in a reverse direction and another set of leaves is produced, the only difference being that this set is the other side up which is an advantage rather than a detriment in the assembling operation.

Should it be desired to make brushes with a greater or lesser number of leaves the only thing necessary would be to change the ratio of the first reduction gearing.

The entire operating mechanism is protected by a cover *K*, made from $\frac{1}{8}$-in. sheet steel.

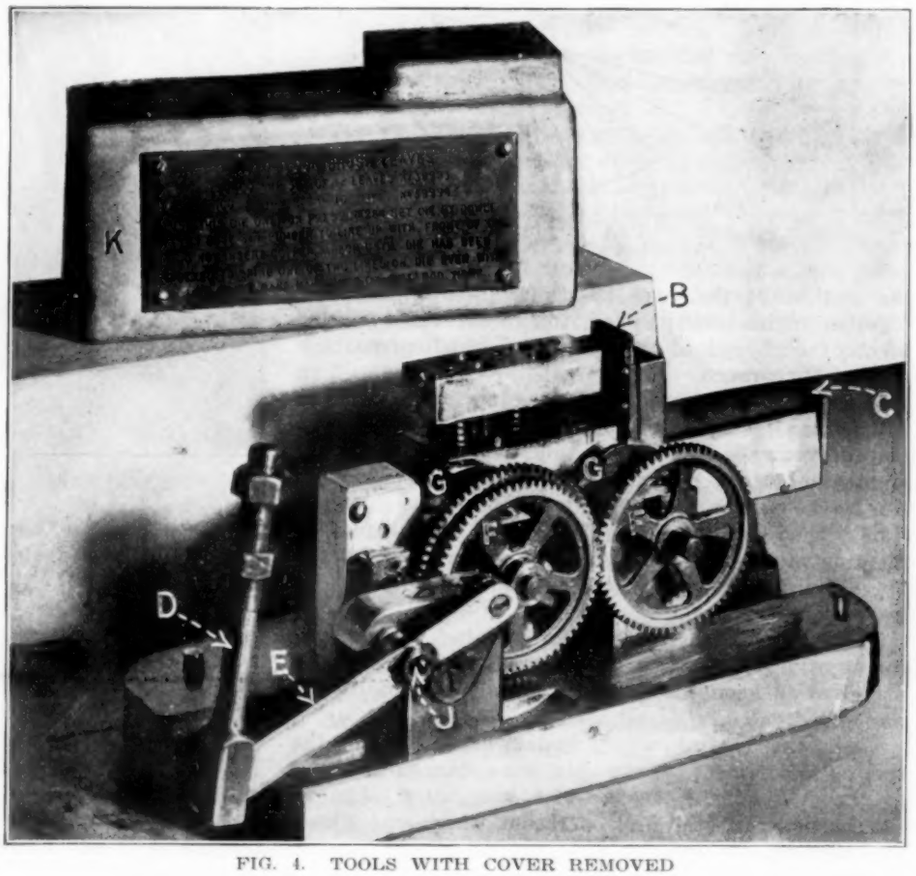


FIG. 4. TOOLS WITH COVER REMOVED

An engraved instruction plate is attached to the cover, setting forth plainly the manner in which the tool is to be used.

The method of handling the leaves after punching is interesting. The long rods on which the leaves are strung are held to the bolster plate of the press by a clamp, as shown in Fig. 3. When the accumulated leaves reach the top of the rods the operator grasps the rods in his left hand, loosens a wing nut with his right hand, permitting a hinged clamp to swing back, and allowing the leaves to drop to the bottom of the holder. When the holder is full, a small clamp (not shown) is slipped over the ends of the rods, pressed down and tightened. This serves as a convenient method of storing the leaves and presents them to the brush assembler in such shape that it is a simple matter to take off one set of leaves at a time and insert them directly into the riveting fixture.

American Machine Tools in Many Markets

By L. W. ALWYN-SCHMIDT

All eyes are turned toward Europe just now for various reasons, not the least of which is the market for machine tools which awaits development. Mighty England, devastated France, crippled Poland and Serbia, the northern and southern neutrals and even hated Germany offer possibilities worth investigation by the manufacturer and the selling corporation. Here is a brief survey of the field.

THE period between the declaration of the armistice and the signing of peace was bound to bring a slowing down of the foreign demand for American machine tools. The machine industry of the world needed time to study the situation. But it would not be surprising to see a recovery in the international machinery market after peace has actually arrived. This will be the most important time for our machinery exporters.

The American machine industry has vastly improved its export facilities during the last four years and has succeeded in winning a large part of the foreign trade which was handled by foreign interests. Several large American corporations representing a great number of machine plants are engaged in exporting American machinery and others are to be added in the near future according to rumors now current.

There is plenty of work just now for the American machinery industry all over the world and it will depend entirely upon the enterprise of our own manufacturers, how large our share will be of the new trade that is to be expected. The commercial agents of the U. S. Department of Commerce have given more than usual attention to this side of the American export problem, and justly, for after all a large percentage of all industrial production consists of machinery of some sort or another.

In the following article an attempt is made to give to the manufacturer, interested in the foreign demand for American machinery, as short and as clear an impression as possible of the character of the present demand and its likely development in the immediate future. The material for this study has been collected from a great number of reliable sources including the reports of the American consuls and commerce experts published in recent months. This information is supplemented by news items collected by the writer from foreign publications dealing with the subject.

A beginning may be made with the European market. With the end of the war the large demand for machinery from England, France and Italy naturally has come to an end. The English machinery industry is now busily engaged in reorganizing its business for the purpose of resuming a normal peace production, and this work is progressing rapidly notwithstanding the many difficulties met by the English manufacturers, including those of labor. The English machine-tool makers organized themselves several years ago into an association which contemplates not only a close coöperation between the individual manufacturers but intends to go a step farther by the introduction of a system of coördinating the manufacturing energy of each member. It is intended to make certain machine tools only in factories especially suitable for that purpose and to bring about in this way a better specialization in production similar to that already existing in the United States. It appears from recent reports that the machine industry is at present largely engaged in repairing and overhauling the present machine equipment of the English factories much of which demands renewal.

Incidentally there is expected an increasing demand for higher class machinery from factories which until now have used cheaper and less effective equipment. Practically all of the English machine-tool equipment is now of the most up-to-date design, having been installed during the war. The older types of tools which were pressed into service during the first months of the war when every unit of machine-tool equipment was urgently required have slowly been eliminated, either because they were worked out or because they proved a hindrance to rapid production when employed side by side with the modern English or American equipment. The English machinery industry, therefore, enters international competition under much more favorable conditions than those existing before the war. It is an interesting question, how the new situation will influence the later-day demand for the better-class American machine tools in England. England has received during the last four years American machine tools to the value of nearly $60,000,000. Many of these tools were bought for special work connected with the war and may prove useless for industrial production. It is, however, a fairly safe guess that several years of good service are left in at least three-quarters of the American machine tools imported into England during the war. These machines will now be taken over into the general industrial equipment of the English machine-building industry. It will depend upon our own abilities whether American tools will replace these when they have to be discarded or whether English ones will take their place. Taking the life of a machine tool at approximately eight years, would mean that

three years are left to our industry to install itself in the English market. Naturally the English machine-tool industry will always have the lion's share of the English and colonial trade. This, however, does not prevent the American machine tool from making itself so useful in English industrial production as to become practically indispensable. Only if we succeed in this respect can we expect to hold the English market or that part of it which our industry has gained during the war.

Impression of Technical Men Who Have Returned from England

The impression of technical men who have returned from England recently seems to be that for the next year too many orders should not be expected from England. Such business as will result from the present situation in that market would be rather of a supplementary nature, filling out gaps which cannot be successfully stopped by the present English production, and applying to machinery required for coördinating the existing American machine equipment. To handle the English business will require careful attention and a close coöperation between the English consumers and the American producers.

The future exports to France will be closely linked up with the progress made in that country with the general reconstruction work. American experts have visited recently the devastated parts of France and their report shows that while the destruction is practically complete in certain regions there are others where only repairs will be required and the latter seem to be in the larger number. The Germans have often not dismantled the whole machine but have confined themselves to taking all the copper and brass parts of the equipment. These parts will have to be repla ed and the machines put into proper repair. As a result there will be an enormous demand in France for general repair shops and it is not clear yet whether France will possess all the equipment required for this purpose.

France, like England, has imported great quantities of American machine tools which have been used to supplement the existing national equipment. Like the shipments to England, the tools have been in a large part special tools for the manufacture of armament and may have to be discarded. Most of the imported tools have been installed in newly erected factories in localities where in former years there was no machine industry of consequence. They may now be removed from their present quarters and transferred to northwestern France to be employed in repair work or installed in the factories which have been left reasonably intact by the war. A great number of special automatic repair machines will have to be imported in the interest of a speedy rehabilitation of the French industries, but this work cannot be hurried on account of financial difficulties and lack of labor. France will receive a war indemnity. This, however, can only repay her in part for the great losses she has suffered during the war and cannot be collected immediately. So French rehabilitation work will proceed at a slower pace than has been expected. This will distribute the French purchases for machinery over a longer period. The peace treaty with Germany will have a material effect on the French purchases of machinery, for if this treaty should prescribe the restoration of the actual machinery by Germany, it would mean that most of these machines will be made in German factories during the next two years. The German nation of course will have to pay for these machines.

This is an eventuality which must be taken into consideration by our own machine-tool manufacturers. It might in fact have a very peculiar and unexpected influence on the direction of our own machine-tool exports after the signing of peace. The German machine-building industry most likely has suffered more severely from the war than the French, because of the different economic position of the two countries. France has been able to buy foreign machine tools and in consequence has been able to replenish her equipment regularly. The German industry had to make all the tools itself. As a consequence much industrial energy which in France could be employed in the conduct of the war has in the case of Germany gone into the building of supplementary machine equipment. Now, when the war has come to an end, the German machine industry sees itself with a large equipment on hand built for the special purpose of the war and with hardly any other prospect for employment. This equipment will have to be modernized at first by more suitable machinery before the industries can work again at a normal basis. If France is to have her machinery replaced by Germany two possibilities are open. Either the machinery will be bought in other countries with German money or Germany will manufacture that machinery. As the German equipment will prove insufficient for the latter purpose, Germany will have to buy it from England or the United States. It is, therefore, not at all unlikely that Germany may be quite a heavy buyer of American machine tools during the next few years until her own factories are able to catch up with their production. The present difficulty in Germany no doubt lies in the enormous social changes which the country has undergone during the last few months. Only men intimately conversant with industrial conditions in the old Germany can understand fully what these changes mean. Whatever may be the outcome of the present turmoil, the German workman will not be again a subservient military-trained being. His outlook on life will be different in future years and the German industry will not be such an aggressive national unit as it has been in years gone by. Such a far-reaching change of the industrial organization of a country like Germany must have a very decisive effect on our own relations to that market. A free-trade Germany or a low-tariff Germany may well consider it good business to buy machines in the United States instead of manufacturing them, provided of course that we are willing to sell them.

Political Changes in Germany

But the political changes that have taken place in Germany are nothing compared to those of all the rest of eastern Europe. Unfortunately, few of our machine-tool makers and general machinery manufacturers are really capable of gaging correctly the importance of the present events in those parts of Europe for our future connection with these new countries. Out of the wreck of two empires arises a series of new nations, all of great national consciousness and desiring to take their place amongst the other nations of the world. It has been the fashion during recent years to call these nations "subject" nations. This, however, does not correctly describe their condition as it implies an industrial backwardness which was the case in only a few instances. The new Bohemia, for instance, has

done very well as an industrial nation in the past and it will start its new national independent life with an excellent industrial equipment which may need supplementing only in so far as the war may have destroyed part of it. The situation is somewhat different in Poland. The old Russian regime had no interest in giving Poland an independent industrial life. Her industries in fact were shaped to be rather supplementary to the great Russian industries further East. If Poland now sets out to prepare herself for the life of a national unit she will have to reconstruct her industries so to make them self-sustaining. This will make necessary the erection of a number of new factories and this cannot be done without the importation of quantities of machine equipment, for very little can be made in Poland. The new Poland has industrially all the making of a second Saxony or Bohemia. She will have her own iron and coal mines and a large and industrious population. Poland therefore will be an excellent market for American industrial equipment and the great possibilities which this country offers for the development of a small machine-building industry should give American machine-tool builders their opportunity.

Ukraine Will Have to Build New Industries

What applies to Poland applies equally to the Ukraine, provided order can be restored in that part of the former Russia. As in the case of Poland, Russia had no interest in allowing a separate industrial development in that part of her dominions and in consequence the Ukraine became an agricultural development only, with the exception of the oil districts. Now after the separation from the empire the Ukraine doubtless will have to build up a new industry of her own, entailing the purchase of quantities of industrial machinery including machine tools. Both countries will be very desirable markets, because they are essentially rich and will be richer in the future. To enable them to buy their equipment from us small loans may be necessary but these loans will soon be repaid. The recovery will be quick and this whole territory may be in complete working order by the end of 1920.

Conditions are somewhat different in Serbia and those parts of the former Austria-Hungary which will be united finally under the Serbian flag. No country has suffered more from Austrian domination than Serbia. Cut off from the sea and dependent for her principal commercial outlets upon Austria the latter had seen to it that no industrial life of any importance should grow. The new Serbia will unite a great part of the old Austria with the main body of the Serbs and will have a proper outlet to the sea. The possibilities of developing industrial enterprise in Serbia are good, but the country has suffered heavily by the war, both economically and in the number of its inhabitants, and extensive and well-placed financial assistance will have to be rendered before we can expect her to buy American machinery.

Turning to the neutrals in Europe the three Scandinavian countries have attracted much attention lately. The great industrial problem of the three markets, Sweden, Norway and Denmark, is today that of raw materials and industrial equipment. Taking it for granted that the necessity of repaying the war debts will force Germany to work largely in the interest of English and French buyers the Scandinavian countries can expect little of either materials or equipment from Germany. Their only source, therefore, can be England or the United States, and the latter possibility seems to find more favor with the Scandinavian buyers. All three markets have been good customers for American machine tools and the most recent statistics show that their interest continues.

Much attention has been shown by our machine-tool manufacturers to the Mediterranean markets, especially Spain and Italy. Spain was the first of the great neutral countries to develop during the war a large demand for American machine tools. She has continued to buy large quantities of American tools and the Spanish industry is now well equipped with many of our best automatic machines. Spain's manufacturing problems are those of a vastly increased demand for all sorts of commodities which must be met by an industrial organization slow in development. Under such circumstances the employment of high-class automatic machinery becomes more than a convenience; it is indispensable. This explains why American machine tools have been in such demand in Spain during the last three years and it also is the reason why no falling off in this demand need be expected in the near future.

Italy is in a similar situation. Having as her neighbors such powerful industrial producers as Germany and Austria the development of many manufacturing industries had been somewhat neglected. This state of affairs is now being corrected with the result that many new factories have been built during the last two years and a still greater number may be erected during the coming period. The Italian demand for machine tools may not be as extensive in peace as it has been during the last years of the war. It will, nevertheless, be very considerable. Part of it may flow to England and Germany. The United States, however, should secure a large percentage of the orders for industrial equipment.

Naturally the after-the-war sales of American machine tools and industrial machinery will not be as large as those made during the war. We can, however, expect confidently a considerable increase above the numbers and quantities of 1913.

Measurement of Plain Rings

By R. L. Rankin
Gage Section, Bureau of Standards

During the peak of war-time gage production, ring gages were submitted for inspection to the gage section of the Bureau of Standards in such quantities that it would have been a difficult problem to inspect them accurately and quickly had it not been for a ring-measuring tool devised previously by the chief of the gage section, in anticipation of just such a condition. This device is simple enough but the accuracy and

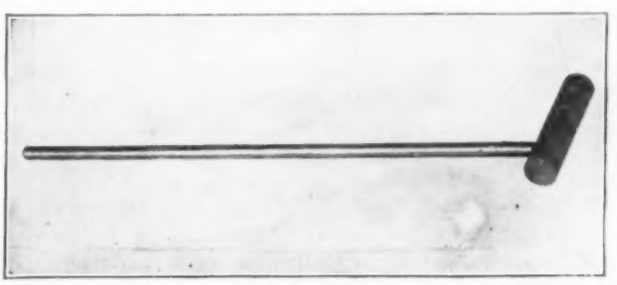


FIG. 1. RING-MEASURING FIXTURE

speed which it is possible to obtain by its use make it worthy of attention. The ring-measuring fixture consists of a carefully ground cylindrical head with a rod driven into it, giving the whole fixture the appearance of a hammer, as shown in Fig. 1. One end of the head is fastened in a clamp set up on a stand. This leaves the other end of the cylindrical head projecting, and it is upon this longer, projecting end that the rings are placed. The under side of this end of the head is cut on a taper as shown in Fig. 2, when the device is to be used for measuring small rings. An indicator is attached to the rod so that the indicator arm has contact with the ring under its point of support. The whole device then acts as a gage for measuring the diameters of plain rings and the amount that they are out of round.

FIG. 2. DETAIL DRAWING OF INDICATOR HOLDER

A zero reading must first be taken from the top of the cylinder across the indicator arm. This is done by means of a micrometer caliper or by means of precision blocks set for the nominal diameter of the rings, Fig. 3. After the zero reading has been taken, the measurement of the diameter of a ring consists simply in setting the gage on the device as shown in Figs. 3 and 4, and noting the difference between the reading of the indicator and the reading observed for the nominal diameter. Variations in the diameter are determined by revolving the ring and noting the changes in the indicator reading.

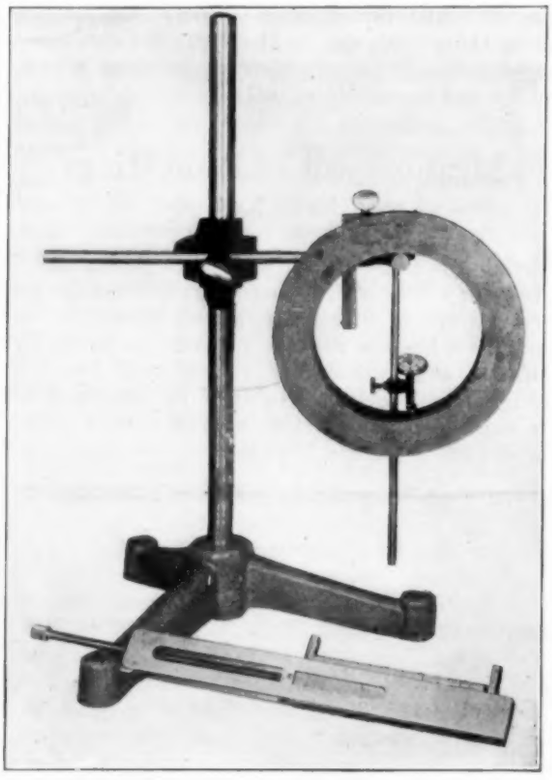


FIG. 3. SET-UP SHOWING PRECISION BLOCKS

No particular care is necessary to get the indicator arm directly underneath the cylindrical support of the ring, although it is true, of course, that if the ring is allowed to hang free and the indicator arm is not in such a position, the full diameter reading will not be obtained. This difficulty is overcome, however, by rocking the ring gently from side to side and taking the maximum reading on the indicator. Thus, in Fig. 3, the ring must be swung to the right to obtain the diameter reading.

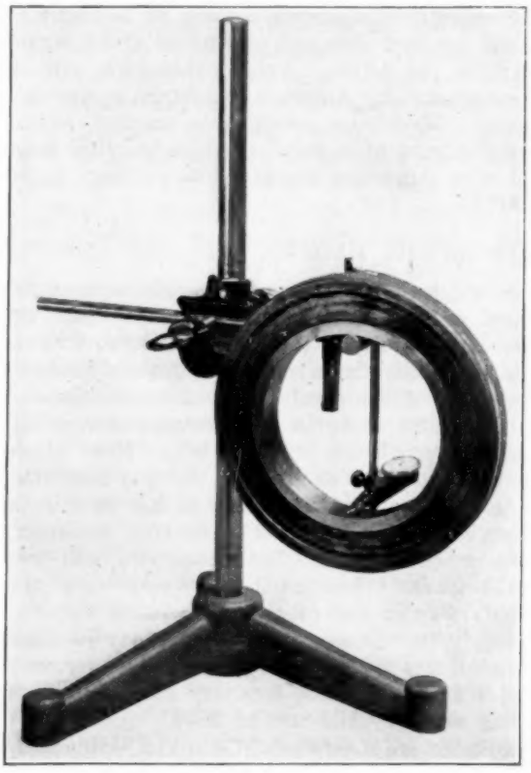


FIG. 4. SET-UP OF APPARATUS

When large quantities of rings of the same nominal diameter are submitted for test, this device is a great time saver and it is accurate within 0.0001 in. In order to obtain this accuracy, care should be taken to see that the supporting rod for the indicator is secured firmly in the cylindrical head. This method is used by the gage section in the inspection of all plain ring gages over $\frac{1}{2}$ in. in diameter and it is of particular value in the determination of the uniformity of the diameters across different points of the ring. Experiments made with the rings in a horizontal position indicate that the elongation of the rings (produced by their own weight when in a vertical position) is negligible.

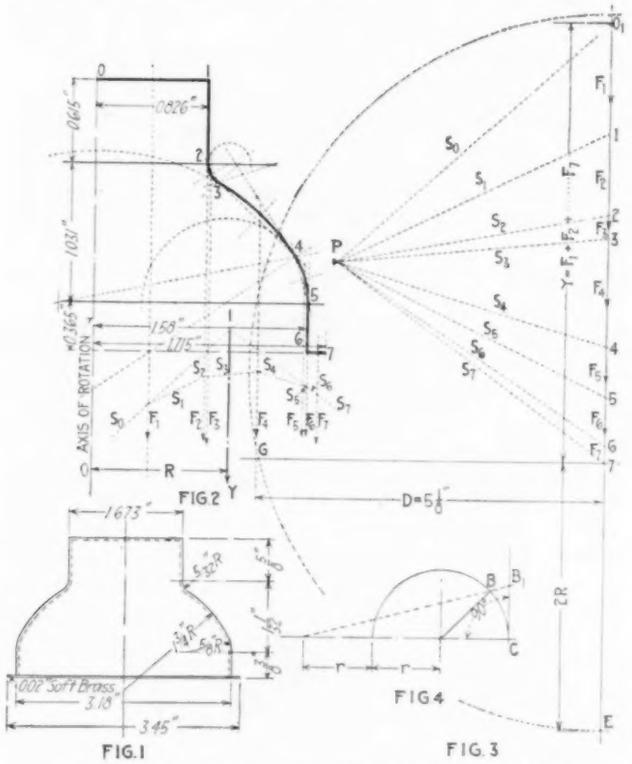
Any one who is further interested in this device will be given any details not mentioned herein, upon request to the Bureau of Standards. Visitors are welcome at the bureau to inspect this or other work in which they are interested.

Blank Diameter by Graphical Method

By Walter Hinman

The American Ever Ready Works of the National Carbon Co., Long Island City, use for their Daylos a number of parts, the outlines of which consist of combinations of circles and straight lines. To find the blank diameter in the usual way necessitates complicated figuring. The following graphical method proves a quick, reliable way and gives entirely satisfactory results by substituting a number of mechanical operations for tedious figuring. It is based on the theorem of Pappus, uses the funicular polygon to find the center of gravity and assumes that the neutral surface of the blank and the finished work are the same.

The theorem of Pappus for surfaces is: Assume that a plane curve, length L, revolves about an axis in its plane but not cutting it; and let S be the length of circular arc traced by its center of gravity. Then area of surface generated by L is $A = LS$. If S = a complete revolution, $A = 2\pi RL$, where R = distance from axis to center of gravity of L.



FIGS. 1 TO 4. GRAPHICAL ANALYSIS OF PROBLEM
Fig. 1—Part to be drawn. Fig. 2—Funicular polygon. Fig. 3—Force polygon. Fig. 4—Rectification of arc CB

The length of the neutral line is easily figured or scaled and the funicular polygon used to find R.

To make the process clear we will determine the blank for the reflector shell of a searchlight Daylo, shown in Fig. 1. In order to get the length of the plane curve L we draw one-half of the finished piece to double scale, Fig. 2. We next rectify the arcs as shown in Fig. 4 and locate the center of gravity of each by assuming that it is on the perpendicular to the chord two-thirds of the distance from chord to arc above the chord. This is close enough for all purposes.

We next assume that a force represented by a vertical line equal in length to the respective portion of the curve acts at each center of gravity. The lines of action of these forces are the dotted lines, F_1, F_2, F_3, etc., Fig. 2, which are projected downward to keep the funicular polygon clear of the figure. We then lay off the forces to scale on the line $0 - 7$, Fig. 3, and choose any convenient point P for the pole of our force polygon. P is then connected to the points $0, 1, 2, 3 \ldots\ldots 7$, by the lines $S_0, S_1, S_2 \ldots\ldots S_7$ and the funicular polygon drawn by making $S_0, S_1, S_2, S_3 \ldots\ldots S_7$ in Fig. 2 parallel to $S_0, S_1, S_2 \ldots\ldots S_7$ in Fig. 3. Through the intersection of S_0 and S_7 we draw the resultant of the forces Y, which will be at a distance R from the center line of the finished piece and be equal in length to the sum of the forces in the force polygon or $0 - 7$.

From the theorem of Pappus, stated above, we can say that the area of the finished piece is

$$A = 2\pi RY \qquad (1)$$

As this should equal the area of the blank which is a circular disk of diameter D,

$$A = 2\pi RY = \frac{\pi D^2}{4} \text{ and } 2RY = \frac{D^2}{4} \qquad (2)$$

D may be found graphically as shown in Fig. 3. This method applies the geometrical proposition which states that if one of two intersecting perpendicular chords of a circle is a diameter, one-half the shorter chord is the mean proportional between the segments of the diametrical chord.

In formula (2) $\frac{D}{2}$ is the mean proportional between $2R$ and Y, for the equation may be reduced to the form of a proportion—$2R : \frac{D}{2} = \frac{D}{2} : Y$. Add $2R$ to Y in Fig. 3, giving the distance $0 - 7 - E$; describe a semicircle on OE as a diameter and erect a perpendicular at 7 which intersects the arc at G and gives $G - 7$ as the length of $\frac{D}{2}$ desired. As this figure is to double scale the value $\frac{D}{2}$ found is actually the diameter of the blank.

A Radius Turning Tool

By E. T. Grimes

The sketch shows a simple tool for turning small radii, such, for example, as the concave face of wormwheels. It is made by forging a boss on a piece of 1 x ½-in. steel, drilling this boss and facing it both top and bottom for the swivelling toolpost. The shoulder of the post where it passes through the boss should be gaged very accurately as to length so that when the nut is tightened the post will turn easily without being loose. The hole for the tool may be round, and the tool may be a piece of drill rod or it may be broached square to accommodate the commercial toolbit of high-speed steel. The toolbit is held by a small setscrew passing through the side of the toolpost.

RADIUS TURNING FIXTURE

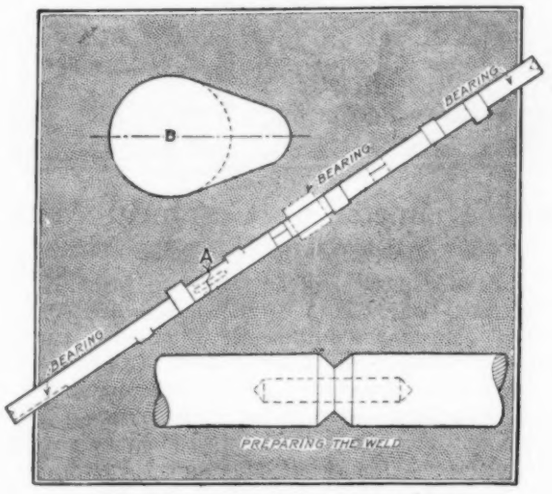
In attaching the handle care should be taken to have it at a right angle to the hole for the toolbit, otherwise it will probably interfere with the regular toolpost in which the shank of this tool is held. Instead of a permanently attached handle the top of the swivelling post may be squared and an ordinary S wrench used for turning it. The radius to be turned is determined by the adjustment of the toolbit.

Welding a Broken Camshaft

By O. F. Kuhlman

The camshaft of a gas engine was broken as shown at *A* in the sketch and it was decided to repair it by welding. The broken ends were first annealed, care being taken not to anneal the cams. Each piece of shaft was then swung up in a lathe and ⅜-in. holes were bored 1½ in. deep in the broken ends. The ends of the break were now beveled to about 45 deg. for the welder, the bevel extending about half-way down to the center.

A pin was driven into the larger piece of shaft first, then the smaller piece was forced onto the protruding end of the pin. The shaft was then put on a surface plate in V-blocks, and with the aid of a surface gage and a pipe wrench the cams were lined up in the following manner: A line was scribed on



WELDING A BROKEN CAMSHAFT

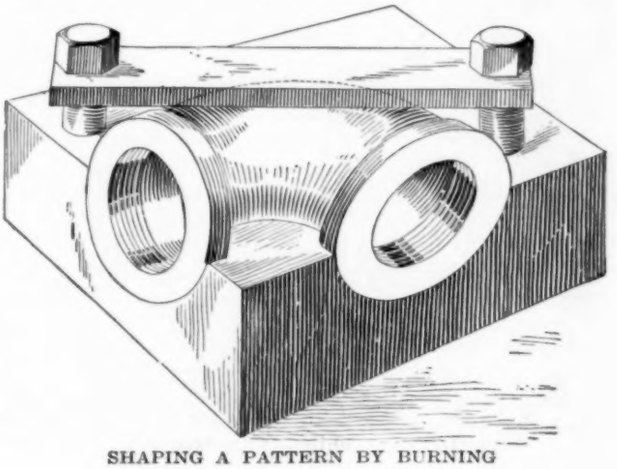
the intake cam of cylinder No. 1, as shown at *B*, and a similar line was scribed on the intake cam of cylinder No. 4. By using the pipe wrench the smaller piece was turned around until the intake cam of No. 1 was directly opposite the intake cam of No. 4 and in this position the pieces were welded together. After it had cooled sufficiently to handle, the shaft was put between the centers of the lathe and straightened. Upon being put into the engine it worked very satisfactorily.

A Quickly Made Holding Jig For Irregular-Shaped Pieces

By Frederick J. Spangler

Having a lot of irregular elbows to thread, it became necessary to provide some means of holding them in the lathe. The number did not seem large enough, however, to warrant any very expensive tools and so we sought a means of doing it cheaply and at the same time effectively.

Taking a block of wood of suitable size the depression was cut out roughly and then finished by heating



SHAPING A PATTERN BY BURNING

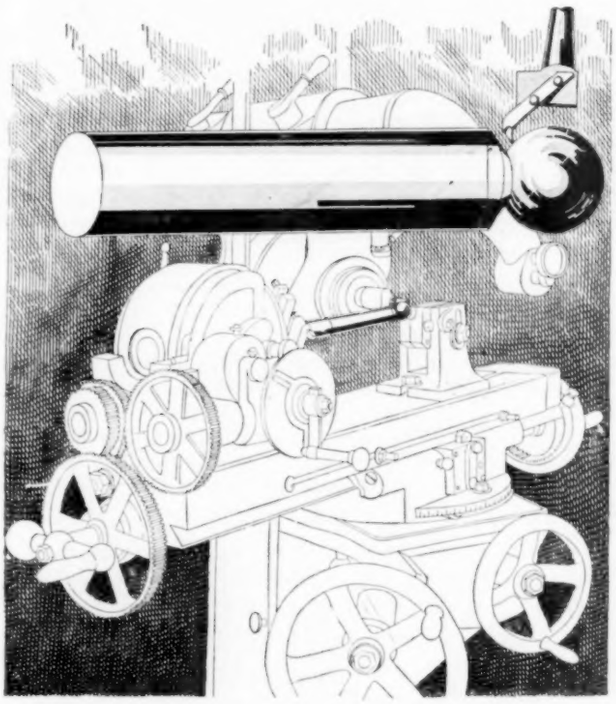
an elbow red-hot and burning the wood with it. With a little care this was done very nicely and the resulting casting required no machining except to drill and tap necessary holes for holding it to the faceplate of the lathe and for fastening the work in position.

Forming an Accurate Ball on the End of a Rod

By Bernie Soule

Many times it is desirable to form an accurate ball on the end of a rod, as for instance in the making of what is known as a ball pitman used on many power presses.

The usual way of accomplishing this is to rough it out in the lathe, operating the traverse and crossfeeds by hand, squinting at the job with one eye shut, until



MAKING A TRUE BALL WITH A FLY CUTTER

the piece assumes a shape that is something between a goose-egg and a door-knob, and then with hand tools, files and templets used in connection with plenty of perseverance, profanity and Prussian-blue, reducing it to a ball that is not *much* bigger in some places than it is in others.

Now it is quite easy to make a tool that will turn a sphere and nothing else—that is, a tool that cannot under any circumstances produce a spheroid—and it does not require any close calculation either. It is based upon the fact that any plane cutting any sphere is bounded by a true circle.

The work (after roughing out in the lathe as described above in order to save time) is mounted in the chuck or on the centers of a dividing head, according to its size. The tool may be a hollow-mill or a fly cutter as shown in the cut. The dividing head and work is placed on the table of a universal milling machine, which is swiveled to an angle dependent upon the manner in which the work is supported and the size of the neck which joins the ball to the rod. If the neck is proportionately small and the work is held on centers, the table need not be swiveled at all, as there must of course be a small tit remaining around the tail center to support the work, which is afterward removed in the polishing operation. Again, if the neck is larger and no tit is required, as may be the case if it is possible to support the work without a tail center, the table may be turned as much as 15 degrees.

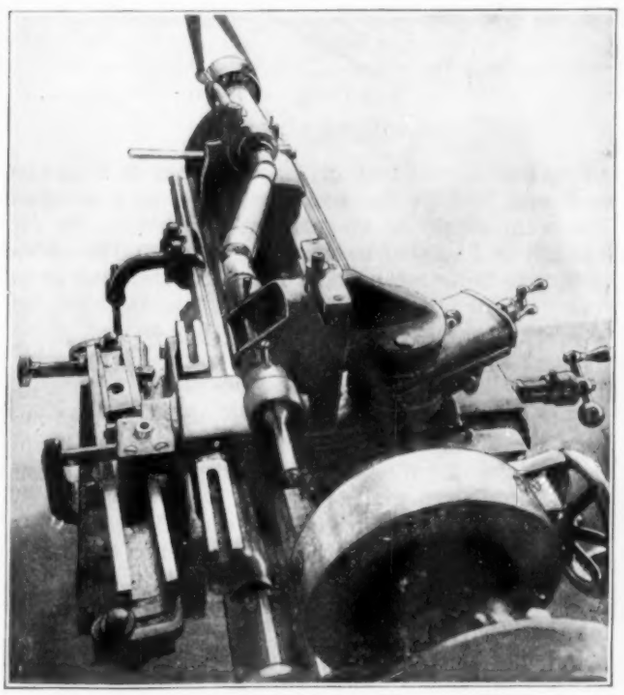
The diameter of the circle swept by the fly cutter may be anything less than the diameter of the desired ball; how much less will depend upon the diameter of the required neck and the angle at which the milling-machine table stands? Whatever this circle may be (below the maximum) it determines only the proportion that the machined surface bears to a complete ball—the sphericity of the portion covered is not affected, whatever its diameter. Thus, it is practicable to reduce the diameter of the ball by feeding in with the crossfeed screw of the milling machine exactly as one reduces the diameter of a shoulder by feeding in the cross-slide of a lathe, and to determine its diameter as accurately by measuring it with a micrometer, with the assurance that whatever the reading shown by the latter it will be the same at whatever angle the measurement is taken, as the ball will always be perfectly round.

By careful attention to the cutting quality of the tool it is possible to make a ball that requires little more to finish it than polishing with emery cloth.

An Internal Thread-Milling Attachment

By W. C. Loring

The internal thread-milling fixture shown in the accompanying picture has been designed as an attachment to a 16-in. Le Blond lathe, which is also equipped with taper, and relieving attachments. The point of view, looking down from above the lathe head, was necessitated by lack of room in which to set the camera and still obtain a comprehensive picture. The device



ATTACHMENT FOR MILLING THREADS

was designed and built by the A. F. Way Co., Inc., of Hartford, Conn., for the purpose of milling the threads in gun-mount nuts, ranging in diameter from 1 in. to 2¼ in. with U. S. Standard threads.

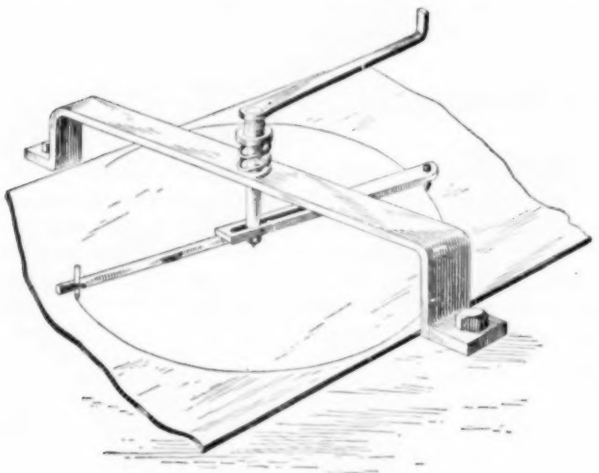
The housing is attached to the compound rest of the lathe and thus can be adjusted to any convenient angle. A swivel, which is part of the housing, allows the cutter spindle to swing in a vertical plane, making the attachment practically universal. The speed of the regular lathe countershaft is reduced to give a suitable rate of feed. The cutter is driven from a small special countershaft and through the medium of a universal joint, the first member of which runs in a long sleeve placed in the position usually occupied by the tail spindle. With this equipment, work of thread-gage accuracy and with beautifully finished surfaces is turned out.

A Simple Gasket Cutter

By M. H. Potter

The device shown in the illustration is easily and cheaply made and will save a good deal of time where there are many gaskets to be made as it will cut both the outer and inner diameters at the same time.

The center pin is made of drill rod and is driven into the larger rod and then ground to a sharp point. The



A GASKET CUTTER

cutter is also made of drill rod ground to a cutting edge and held in the beam by a headless setscrew. The beam should be of sufficient length to cover any job that is likely to be encountered. Adjustment for diameters is by means of a nut on the central arbor.

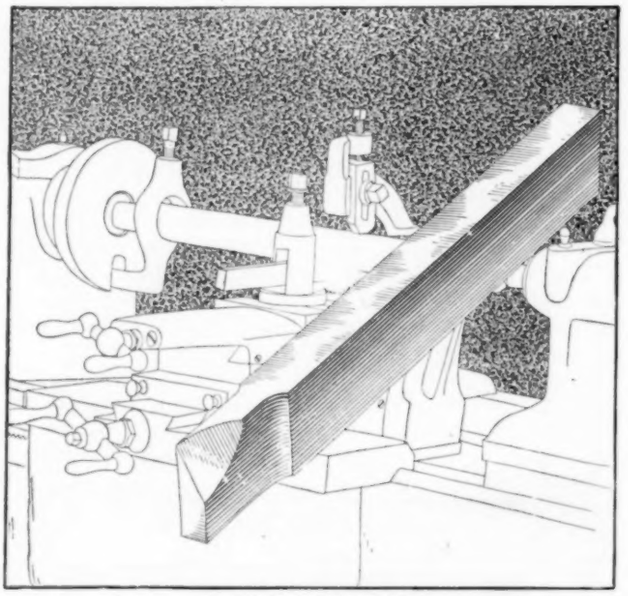
A Finishing Tool for Smooth Surfaces

By C. E. Liebensberg

The sketch shows a cutting tool which at first may seem irrational to the average mechanic, but having used it myself for several years with success I recommend it for good results.

It is purely a finishing tool for the lathe, shaping, or planing machine and has the rake ground on the cutting side while it travels against the rake instead of from it. It has a shearing effect, delivering a coarse-pitch, tube-like shaving.

It holds the edge longer than the ordinary or conventional type as it needs no "lip." The cutting edge is ground approximately 45 deg. from the vertical. The front is ground slightly convex for flat surfaces; more so for boring, and flat, for turning or cutting circular work externally. It gives a finish approaching that of, if not as good as, a spring tool, with the



A FINISHING TOOL

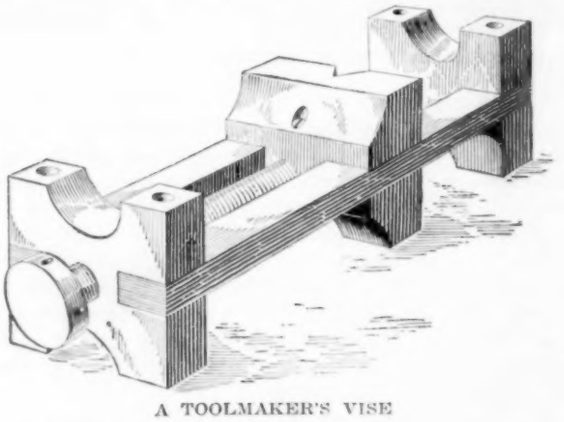
advantage over the latter that it makes no depressions in the work. Another advantage is that it cuts a perfect shaving of less than 0.001 in.

[The principle of this tool is the same as that of the "twist-lip" tool, familiar to the older mechanics.—Editor.]

Small Vise for Toolmakers' Use

By Charles Sehl

The sketch shows a tool that is a cross between a vise and a clamp which I built for my own use and I have found it very handy for many purposes for which the regular toolmaker's vise is unsuitable. With the



A TOOLMAKER'S VISE

exception of the screw it is all made of cast iron, though that is, of course, not essential. It has the advantage of not requiring a special casting or forging as it is made of small pieces held together by dowel pins. The end pieces are cut away, as shown, so that the tool has a four-point bearing either side up. Care should be taken to make it square in every direction so that it may be used in any position.

Standardization and Interchangeability; Factors Which Help or Hinder According to the Work in Hand

By FRED H. COLVIN
Principal Associate Editor, *American Machinist*

The desire for standardization and interchangeability, commendable in itself, sometimes leads us to extremes which are not only unprofitable but which defeat the object to be attained. This article shows some of the pitfalls to be avoided and indicates the opportunities for increasing production and decreasing costs by a careful consideration of all sides of the problems.

ALL agree that economical production is the great need of the country to enable it to recuperate from its extraordinary expenditures and to enable it to supply its own needs and the needs of others less fortunately situated. This means that we must carefully consider all the factors which enter into production and abandon practices which have proved too costly for the results obtained. It means that we must take advantage of all the experience gained in our war activities and profit by it.

Perhaps the most important point for consideration is that of interchangeability, as this question has been prominent from the beginning of the introduction of modern shop methods, and is the most talked-of and the least understood factor in manufacturing. At the risk of being elementary we may say that parts are interchangeable when they will go together satisfactorily without fitting. But here the word "satisfactorily" leaves room for arguments of many kinds. Agricultural machinery is very largely a foundry product and it can be and is made satisfactorily interchangeable with very little machining of the various parts. Even after considerable wear has taken place a new part can be used, as the extra "play" or looseness of fit is not objectionable for this class of work.

Rifles and other arms and ammunition present a very different problem. The parts must fit each other quite accurately to obtain proper functioning. The exact tolerance which can be allowed and still secure this functioning is naturally a matter of dispute in many cases. With agricultural implements on one hand and airplane motors on the other we cover about all the field of machine building.

Before going further, however, it is well to consider carefully just how far interchangeability is either necessary or desirable and also just what quality of interchangeability is needed for the particular work in hand. For we have wasted thousands of dollars during the past two years in unnecessary refinements, not to mention the precious weeks and months which slipped away while we were chasing the interchangeability fetich to its illogical conclusion.

From the standpoint of assembly alone there can be no question about the advantage of complete interchangeability. If this can be secured with wide tolerances, as in the case of agricultural farm machinery already referred to, it would be foolish to consider anything else. But when this fetich demands such accuracy as to cause the rejection of from 25 to 50 per cent. of the parts machined there are other factors which must be considered. Ease of assembling alone can hardly justify the scrapping of thousands of dollars' worth of parts which might easily be used if absolute duplication were not insisted upon. The importance of this exact duplication must be carefully weighed not only by the theorist alone but by the practical engineer who can consider proper functioning, first cost and repairs and balance these factors as they should be.

Those who demand absolute interchangeability think only of two things—the assembling and the replacing of broken parts. These were the considerations which made the original demand for complete interchangeability in the airplane motor. These demands overlooked the fact that in the case of the rifle practically no repairing is ever done away from a base shop, and that with the motor enough wear has always taken place to make fitting of bearings, etc., a necessary part of the work. In other words, they fail to realize that unless absolute interchangeability of parts is a help in manufacture and in repair it can be (and is) a serious and expensive hindrance.

Selective Assembly

Becoming elementary once more it is evident that as tolerances are necessary some pieces will fit more loosely than others. If for example we get a minimum pin in a maximum hole, the fit is decidedly looser than as though a maximum pin was put in a minimum hole. If we can tolerate a play of say 0.002 in. in a fit we would, if we desired, make our total tolerance 0.003 to 0.004 in. and never exceed the 0.002 in. by using the large pins in the large holes and the small pins in the small holes. In other words, we can use selective assembly, as is done in many places.

This does not mean that the assembler wastes time by picking up and measuring pieces to get those which fit together best. He has no such bother or delay. The inspection room sorts the parts as they go through for final inspection and puts them in boxes with identifying marks which show the assembler just what parts to use. One of the best-known builders of high-grade automobiles assembles cylinders and pistons in this way and their quality of workmanship is never questioned. Its engineers know full well that long before the motor

ever needs repairing the wear will make oversized pistons necessary.

Selective assembly would have reduced the cost and increased the output of rifles and many other munitions without in the least interfering with their proper functioning. A large maker of high-grade guns told me that if he could confine absolute changeability to the few parts which were necessary to the proper functioning of the arms, his factory could increase its output at least 40 per cent. In another factory I have seen a rifle which was made up entirely of parts rejected by Government inspectors, yet which not only functioned perfectly but also made a very high target score on the firing range.

A similar condition existed in the building of Liberty motors and unnecessarily delayed production as well as increased the cost. Thousands of dollars' worth of perfectly good parts were sent to the scrap pile in the earlier days of the work, at the time when we needed motors the most. The fetich of interchangeability was too strongly intrenched in the minds of the engineers who set the tolerances to allow them to see the need of rational dimensions and to discriminate between the vital parts and those in which wide tolerances were perfectly permissible. The inability of any factory building these motors (all of them accustomed to accurate work) to obtain satisfactory production, led to much more liberal tolerances in many cases. These were camouflaged under the head of "deviations" from the specifications and many variations which caused vital parts to be scrapped early in the game were allowed to pass when it was found that they gave satisfactory service and that the tolerances demanded were neither necessary nor practical.

Consider Your Own Product

Instead of being swept along by the tide and demanding absolute interchangeability of all parts, every manufacturer should consider his own product and its needs. If it must interchange with other parts in other machines, as in the case of spark plugs, oil cups, motor drives, etc., the accepted standards should be adhered to on the parts which fit the other machines. The rest of the product should be considered from the various angles of manufacture, of parts, assembly used and of replacements. The question of use or proper functioning should properly come first, as this affects all the rest.

If, as in the case of such munitions as time fuses, shrapnel, etc., the part is used but once and is then destroyed, proper functioning is the first question which must be considered. Wear and replacement or repair do not enter into the problem. Manufacture of parts and assembling so as to function properly are all that need be considered. Perfect screw threads, such as required to resist wear, are unnecessary so long as they hold sufficiently well to keep the parts together until the grand finale—the explosion and destruction of the piece. Except from the assembling point of view interchangeability of the components is unnecessary, as there are no replacements. Selective assembly with fairly wide limits would in most cases give all that is required.

The building of airplane motors and other machinery presents entirely different problems. Certain parts are subjected to wear from the time the motor goes into service. The cylinder and bearings wear large while the pistons, shafts and pins wear small. Other parts, such as the valve rocker-arm housing on the motor, while subjected to wear in the bearings, have no other vital dimensions. The exact height from the cylinder is not vital because the play between the valve stems and tappets could be taken up with shims, or distance washers, or in other ways.

Repairs Require Fitting

Here then is a piece in which considerable variation in height could be allowed, and on account of the nature of the work and the general springiness of the aluminum casting it is a good policy to be liberal in tolerances. In replacements, fitting and adjusting must be done in any case. Cylinders, pistons, rods and crankshafts can never be replaced without fitting if the motor has run for any length of time. The parts should be interchangeable to the point of being easily fitted, but beyond that it is impossible to go where accurate work and close-fitting bearings are necessary.

There are many parts in automobiles not subject to much wear which can be replaced without fitting. Brake rods, speedometers, gears and cables, spring leaves and shackles and similar parts can be replaced by a novice because there is little wear on the portions which fit and close tolerances are not necessary. Replacing a broken ball in a ball bearing, however, becomes a serious problem if the bearing is subjected to a heavy load. A new ball, even very slightly larger than the rest, might take the whole load and either crack, crush or score (or all three) the races, in a short time. The only safe way is to measure all the balls with extreme care and select a new ball of the same size.

In making machine tools all builders endeavor to make the parts interchangeable to a degree which gives ease of assembling. They make such units as gear boxes interchangeable, as units, so they can be placed on any machine without fitting. But if there is a gear in one part which must mesh accurately with a gear on another they wisely put in some sort of an adjustment so that the shafts can be moved into the exact engagement they desire for quiet running. This strictly speaking is not interchangeability, but it is far more sensible and practical than the other method. And in case of replacement after use it would be necessary to do fitting just the same.

We make headstocks, tailstocks and carriages in special fixtures so as to have the lathes go together easily in the assembling room, but we would never think of ordering a new headstock or new carriage and expect to use either without being sure that it lined up just right, and we would be very much surprised if no fitting or scraping was required to put

the parts in line with the old bed and tailstock. In the case of the carriage we should find the bed worn more at some portions of its travel than at others, more on the front way (or shear or V) than on the back, and would expect to scrape the ways until it lined up well enough at all points for our particular work.

If we have had experience we will not try to locate one part accurately on another by means of screws, but will locate with nicely fitting dowels and use cap-screws or bolts, which do not pretend to be very close fitting in the hole of the piece being attached. It seems to be one of the next-to-impossible things to get bolts with the body and threaded part exactly concentric or to tap a hole exactly concentric with the drill. This is particularly noticeable in aluminum or bronze, but holds reasonably true in all metals. For this reason screws or bolts which position parts that must be held accurately should not depend on the tapped hole to do so. All positioning should be done by a dowel pin or by the body of the bolt, and the threaded position should be loose enough not to bind the body of the bolt.

The quality of work as well as the material to be used should conform to the requirements of the part being considered. There are places where a cast-iron bearing or a cast-iron gear answers every purpose as well or better than if made of alloy steel and heat-treated. Every part should be made plenty good enough for its purpose with a fair margin to be on the safe side. But to use a drop-forging with many operations, when a piece of steel rod formed in a wire-bending machine will answer every purpose, is a foolish waste of time, money and material.

The cost of material, machining and assembly, the use of the piece and the wear it will receive, the likelihood of its being replaced and whether or not this can be done without some fitting are all questions which the manufacturer who desires really economical production must study most carefully.

Standardization and interchangeability can be and have been overdone in many instances. We have demanded much greater accuracy than was necessary in too many cases. When a machine is made of material possessing all the necessary qualifications for the work it must perform, when the work is sufficiently accurate to function satisfactorily, when it can be assembled and repaired economically, it is a good commercial product. Better material or greater accuracy would be an economic waste.

It may happen that the increased cost of assembly due to wide tolerances and selection may pay for much close work in the machining operations. Generally speaking the waste due to scrap is increased with the narrowing of working tolerances, although there are shop managers who have had the opposite experience. But in any case the costs in each department must be balanced against the others, including the cost of making replacements and repairs.

No matter what the tolerance the use of limit gages is to be carefully considered, and there are few cases where they are not to be recommended, especially for inspection. As working gages they are apt to be more costly than many anticipate, owing to wear when used on running work or rough surfaces, as is sometimes done. Here again the costs must be balanced against results in each case.

But no matter what sort of measuring instruments are used always keep the shop, or working, tolerances smaller than those allowed the inspectors. In this way the amount of scrap is materially reduced. The practice of selecting gages with the least variation for the inspectors has been the cause of a vast amount of spoiled work. This has been emphasized by the war work of the past two years, most of it in shops where gages, and particularly limit gages, were almost unknown.

Another factor which affects production and which is misunderstood in many ways is that of accuracy or conforming to close dimensions. Unnecessary accuracy is as uneconomic as it is foolish. Unnecessary accuracy on a mowing machine would be as foolish as cabinet work on a chicken coop. Hand finish or exact dimensions on a rifle stock (except of course where the barrel rests) is as unnecessary as on a broomstick.

Close-fitting bearings are a real detriment to some classes of machinery and absolutely necessary in others. Locomotive-rod bearings must be left loose or they will bind and heat. Automobile-motor bearings are usually fitted very tight and allowed to wear in by easy running for the first 500 miles. Airplane-motor bearings are fitted closely, but not so tight as those for automobile motors, as there is no slow-running period in airplane work. They also require more careful fitting than for those in automobile motors. Each should be fitted as best suits its needs, but unnecessary refinement should be avoided.

Much discussion has been published in these columns on doing the best work possible in all cases as against making it sufficiently good for the purpose and avoiding the waste of time due to making it better than necessary. The latter contention is very evidently the more sensible in every way. The absurdity of making a pattern for one casting as thoroughly as though it were to be used indefinitely should be apparent to all.

Quality of work, standardization and interchangeability are all questions to be carefully considered by every manufacturer who is looking to the future. And each manufacturer must consider them from the standpoint of his own method of manufacturing. There are great opportunities for wasting money in all of these directions and handicapping him in the coming race for markets. Never before was there such a need of competent judgment in the planning and carrying out of machine shop work, and this entirely aside from the question of labor or personnel, which is far more important now than even before. Never was there such a need of competent engineers with more experience and common sense than was ever required in the days gone by. Practical common sense, not theory, is needed at this time. Scientific managers or efficiency engineers of the old sort will not fill the bill. The first thing is to know what to build and what engineering features are

needed rather than the exact routine by which the work is carried out or followed up. That is mere routine; the other requires real judgment.

The experience of the past two years has developed many good engineers who will be found of great value along the lines indicated. They should be frequently consulted if not kept on the job permanently. No business which hopes to succeed in the days to come can afford to ignore the engineer to assist the business manager to meet all the emergencies which will arise. There is work enough for both, and only by the closest coöperation can the best results be obtained. We must not be handicapped by the traditions or fetiches of the past, but must each choose what is best for his particular line of manufacture.

Automatic Drilling Machine Feed

By E. Ferber

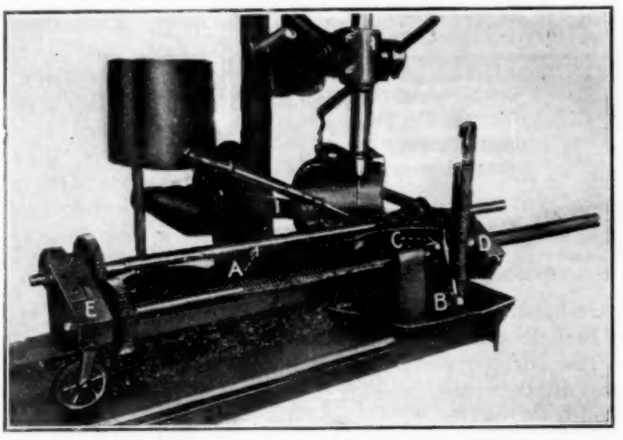
The illustration with this article shows how a manufacturing job, which was a somewhat tedious manual operation, was, by the exercise of a little native ingenuity and the use of a few odd parts taken from old machines in the discard, converted to machine production with practically no outlay for material and little cost for time. The work to be done was the drilling of the small holes in the pipe shown at *A* in the cut. Accurate spacing of the holes was not essential and the drilling had been done for some time by boys, who would hold the pipe in a V-block on the table of a sensitive drilling machine, spacing the holes according to the judgment of the boy so that they would look about right.

As there were a lot of the pipes to be drilled, the job got to be very monotonous; the boys would lose interest in the work, fail to pay proper attention to the matter of spacing the holes and holding the pipe, with consequent loss due to drill breakage. Boys would get so tired of doing such tedious work that they would "jump their job" and it became a problem to get boys sufficiently intelligent to do the work well and yet so lacking in ambition as to be willing to do it. It was really for this reason that the master mechanic devised the scheme here described, but aside from getting out the work, the new device practically eliminated drill breakage, reduced operating cost to almost nothing and greatly improved the quality of the work.

The work is done now, as it was previously, on a multiple-spindle sensitive drilling machine, but only one spindle is used. The casting *B* was a part of a special machine that had been discarded, and the fitting of the bracket thereon with the ratchet, lever, and pawl, which is partly disclosed at *C*, was practically the only special work put upon the device aside from the assembling. The hole in the bracket is not threaded nor is the one in the smaller bracket to be seen just beyond the spring, these two holes serving only to guide the feed screw. This screw is a part of the lead screw of an old lathe. As may easily be seen from the picture its days of usefulness as a lead screw are long since past, but it fits into this scheme perfectly. The sleeve of the ratchet has a key fitting the spline in the screw which serves to transmit the rotary movement.

The nut *D*, another relic, is made in two parts and hinged together so that it is necessary only to move the latch and open the nut to remove it or transfer it from one part of the screw to another. A projecting screw-head resting against the bracket prevents the nut from turning with the screw, and as the movement is always in one direction, this is all the fastening that is required. To reset the machine for a new piece of pipe, the nut is opened and transferred to the end of the screw. The movable part *E* rolls along the table of the machine upon sheave wheels that once carried a weighted cord for some purpose or other, and is guided solely by the screw passing through the two brackets on *B*. The gears connecting the screw and the work spindle are change gears from a lathe. They are of the same size, but this only happened so, as they were chosen to conform to the center distance already established by the piece of scrap material which constitutes the carriage.

A piece of pipe to be drilled is set in the machine by slipping the end over the stud that carries the driven gear and putting in the pin *F* which passes through a previously drilled hole in the pipe and a corresponding hole in the stud. The outer end of the pipe rests in a V-block under the drill. The drive for the whole device is a worm and wormwheel located on the back of the part *B* just out of sight in the picture.

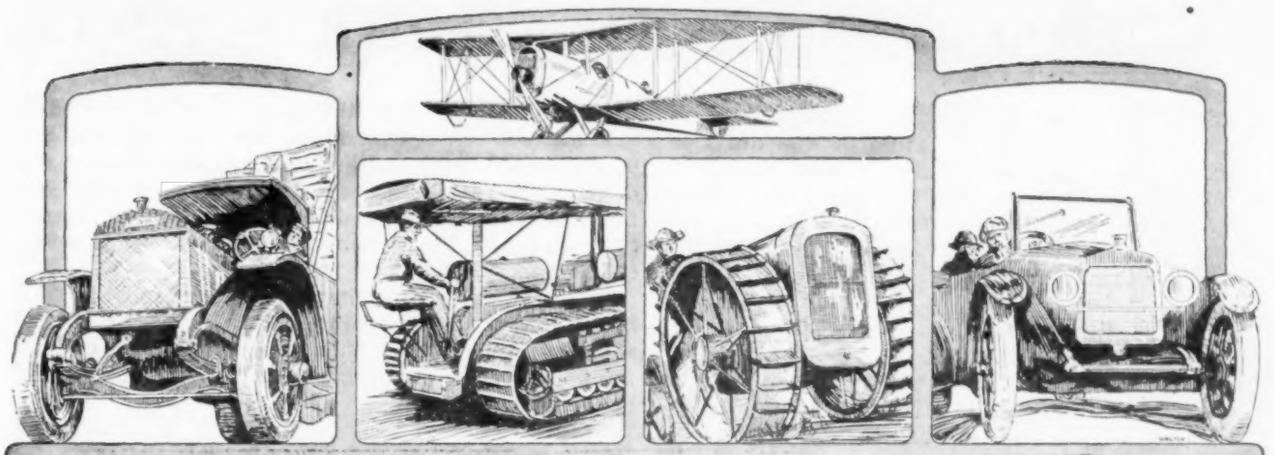


IMPROVISED AUTOMATIC DRILLING DEVICE

The wormwheel operates, through connecting-rods, the drilling lever and also the ratchet lever that feeds the work forward.

The cycle of operation is obvious. With the carriage run to the left as far as it will go a piece of pipe is pinned to the stud and the machine is started. The drill advances quickly to the work but slows up as the crankpin which operates it nears the center so that when the drill breaks through into the orifice of the pipe the movement is very deliberate and little trouble is experienced from drill breakage. As the drill rises from the work, the ratchet is stepped forward, giving the screw a partial rotation, and through the medium of the gears a partial rotation is also given the pipe. Again, because of the nut *D* which is clamped about the screw, the pipe and screw are drawn forward an amount equal to the lead of the screw for the distance turned. Thus the resulting line of holes in the pipe is a continuous helix the exact counterpart of the thread of the screw except that the direction of lead is reversed.

Though the action is considerably slower than could be accomplished by hand, it is continuous and not subject to the drawbacks due to manual operation. All that is necessary for the operator to do is to put in a piece of pipe and start the machine, after which he is free to continue his other work.



AUTOMOTIVE CONSTRUCTION

Making an Automobile Wrench in Two Operations

BY HUGO F. PUSEP

The automobile wrench, described in the following article, was formerly made in three operations, but when it became necessary to make a second set of tools it was found practical to reduce this number to two. A valuable feature in follow dies of this nature is the system of sliding stops for the guidance of stock until the regular latch stop comes into action.

THE double-ended wrench shown at *A*, Fig. 1, comprises a part of the regular equipment of tools furnished with a popular-priced automobile, the hexagon end being for the hub caps of the wheels. Formerly this wrench in a modified form was a steel casting, but owing to its weight and the necessity of machining the openings to size, the design of the wrench was slightly changed and now it is made of No. 9 gage (0.156-in.) sheet steel on the punch press at one-fifth the cost of the cast-steel wrench. A reinforcing flange is formed around the wrench openings, at each end as at *B*, Fig. 1, while the bead *C* serves to stiffen the middle part or handle. The blank is shown at *D*. This wrench is made complete in two operations.

Fig. 2 shows the first operation die, which is of the progressive piercing and blanking type. The cast-iron die shoe *E* has four guide posts which are a sliding fit in the corresponding holes of the punch holder. As may be seen from the sketch, the die proper is built up of sections let into suitable openings milled in the die shoe, the sections coming flush with the top of the cast iron and being held in place by screws and dowels.

In order to save stock the strip of material is passed through the die twice, the dotted lines showing the position of the holes punched in the stock on the first pass as they appear when the strip is reversed and passed through the second time. In operating this die the stock, which comes in strips 11 in. wide, is fed under the stripper (not shown) to the first sliding stop *F*, shown in dotted lines. These stops are made of flat steel and slide in grooves milled on the underside of the stripper.

On descending, the punches pierce the holes *G* and *H*, after which the stop *F* is pulled back and the stock is pushed forward till it comes into contact with the second stop *I*. This stop locates the two holes already punched approximately over the blanking die opening *J* where the pilots enter the holes when the punch comes down and lines them up to the outline of the die opening. At the completion of this stroke a wrench blank is punched out and drops through the die into a tote-box. The stop *I* is then pulled back and the stock advanced till it is stopped by a regular latch stop *K* which works in a slot cut into the stripper plate and is pivoted on a pin. After this stop is reached, the operator simply pushes the strip against the latch at each stroke of the press, till the entire strip is fed through the die. The strip is now turned over and passed through the die a second time, the sliding stops *L* and *M* locating the strip correctly, as already explained in the case of the first pass, till the latch stop *K* drops into the punched hole and thereafter locates the material for each stroke of the pass. As can be seen from the sketch, the latch stop is set somewhat to one side of the center line of the die, and it is also of such form that it slides over the narrower part of the hole that was punched on the first pass of the stock but drops into the opening that was punched on the second pass, thus locating each alternate hole in the stock.

Pilots in the blanking punch are cylindrical, as indicated by the dotted lines at *N* and *O*. The hole *G* in the die is about $\frac{1}{8}$ in. longer than in the punched wrench blank, this being necessary to produce clean sharp corners at *P* in the blank. This construction is used in all dies where the punched hole runs beyond the outline of the blank.

Second-operation dies are shown in Fig. 3. Both the punch holder and the die shoe are made of cast steel of heavy cross-section, in order to withstand the stresses incident to forming. The position of the punches and dies is reversed, the former being attached to the lower member. Forming punches *A* and *B* are machined from

AUTOMOTIVE CONSTRUCTION

tool steel of cylindrical form, leaving round heels which fit into flat-bottomed holes on the shoe and are held in place by screws and dowels. The stripper plate *C* is made of hardened tool steel with the holes a free sliding fit over the punches. As can clearly be seen from the cross-section view this stripper is very thick for the

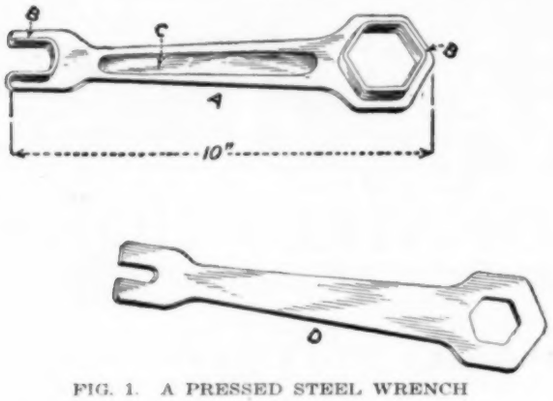


FIG. 1. A PRESSED STEEL WRENCH

reason that it serves also as a flattener for the wrench blank and a die for forming the bead on the handle of the wrench. Several stiff springs of rectangular-section wire are provided under the stripper plate. One of these is shown at *D* which also shows the form of the special shoulder screw which limits the movement of the stripper plate.

The upper member of the die is made in three sections *E*, *F* and *G*, all of tool steel, hardened and ground. They are held in place by fillister head screws and dowels. The dies are counterbored from the back to

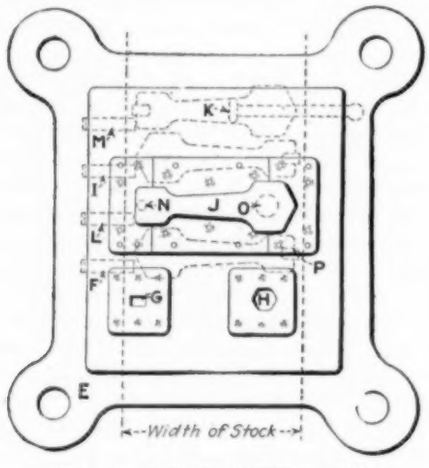


FIG. 2. THE BLANKING DIES

accommodate shoulders on the knock-outs *H* and *I*, the faces of the latter coming flush with the faces of the dies. The knock-outs are a slip fit in the die openings of similar shape and are backed by extra heavy springs. The bead-forming punch *J* is set into a corresponding slot through the center of the die, and this punch has a heel which is backed by a hardened and ground tool-steel plate *K*.

Only two guide posts are provided and as they serve merely to keep the punch and die in alignment during the setting up and clamping of the tools in the press they are made of small diameter. Two hardened-steel nest plates *L* are set one at each side of the open end of the wrench blank and held by flat-headed screws and dowels. These plates are of a thickness slightly less than the wrench blank and their function is to prevent the open end of the wrench blank from spreading under the forming operation.

In operation, this forming die works as follows: The blank from the first-operation dies is placed on the stripper plate of the forming die, the bevelled corners *M* of the punches entering and locating the holes in the

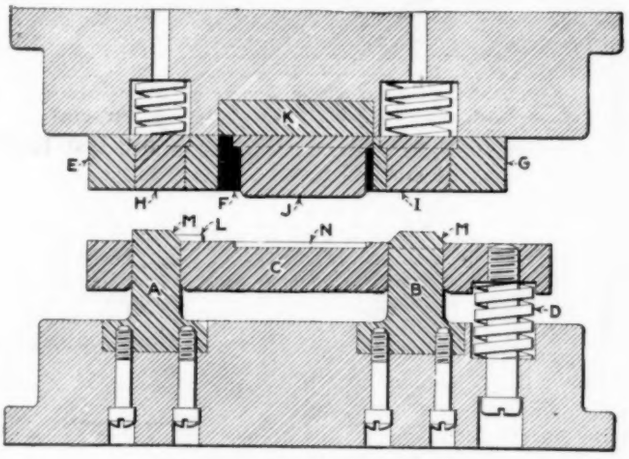


FIG. 3. THE FORMING DIES

wrench blank correctly. In this position the wrench blank nearly touches the stripper plate. When the press is tripped, the upper half of the die descends and carries the wrench blank down over the punches *A* and *B*, together with the stripper plate, till the latter comes in contact with the upper face of the shoe.

This operation completes the wrench by forming the flange around each of the wrench openings, the bead being formed at the same time by the beading punch *J* forcing the metal into the depression *N* of the stripper plate. The press is set so that at its lowest point it comes down hard enough to iron out any wrinkles in the formed blank. On the upstroke of the press, the finished wrench is stripped from the forming punches by the stripper plate, the knock-outs stripping it from the forming dies.

THE FORMING TOOLS

The forming tools are built first and a trial blank is then filed out by hand. A record of this blank and of all subsequent trial blanks must be kept, so when the right form of blank has been obtained, the piercing and blanking die can be laid out from this blank. The easiest way of keeping this record is to file out two identical blanks at each try, one to be formed up and the other to keep for reference and final lay-out blank. The bevelled corners of the forming punches are ground off to suit the developed blank.

A Bliss press of 5-ton capacity was used for the first operation, and a 50-ton double-crank, back-geared press for the second. The completed wrenches as they come from the forming dies need only a polishing operation to remove the burs and are then ready for plating.

CALDWELL BILL

Reintroduced

MOST of you remember the Caldwell Bill, H. R. 15,625, which was introduced in the last session of Congress and which proposed to loan machine tools to educational institutions. This bill, like many others, met its fate in the Sixty-fifth Congress in failing to come up for consideration in the Senate during the last few days of congested legislation.

This bill was reintroduced on May 26 by Mr. Caldwell under the number H. R. 3143. An addition has been made to its terms insomuch that in the present bill it is proposed to include "scientific instruments" as well as machine tools. This is a very commendable addition and will enable colleges of civil and electrical engineering and the like to get instruments and apparatus that they could not obtain in any other way. This bill, like the original bill, proposes to *loan* these tools and this scientific equipment to schools at the discretion of the Secretary of War. There was some comment with regard to this arrangement in the original bill, that it would be more advisable to give these tools to the schools or to sell them outright at a nominal price.

It would seem inopportune at the present time to have any division of opinion regarding the details of this bill when such division might tend to defeat its passage. Whether these tools are given away, loaned or sold at a nominal sum will make little difference in carrying out the spirit of the bill, which is to put these tools where they will do the public the most good. Those who oppose the loan of these tools on the ground that they will have an insecure possession of them need have little fear that the title to them will be transitory. The sole possibility of their being called back (aside from flagrantly improper use) is in the emergency of war. If we have another war, trade schools and technical schools will be commandeered anyway and the tools along with them, whether the title is held by the Government or by the school. But anticipation of trouble on this account is rather far-fetched.

We urge everyone who is interested in the promotion of technical education, and thereby the development of the immense natural resources of America, to get back of the Caldwell Bill, H. R. 3143. Write your Senators and Congressmen, and particularly Chairman Julius Kahn of the House Military Affairs Committee, Washington, D. C., that you are in favor of this bill.

66th Congress
1st Session

H. R. 3143

In the House of Representatives, May 26, 1919.

Mr. CALDWELL introduced the following bill, which was referred to the Committee on Military Affairs and ordered to be printed:

A BILL

To provide for further educational facilities by requiring the War Department to loan certain machine tools and scientific instruments not in use for Government purposes to trade and technical schools and universities, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War shall lend to trade and technical schools and universities and other recognized educational institutions which in the discretion of the Secretary of War should have such equipment the machine tools and scientific instruments suitable for their use which are owned by the United States of America, which are under the control of the War Department, and which are not being used for the Government purposes: *Provided, however,* That each institution so equipped shall be responsible to the United States of America, under regulations to be prescribed by the Secretary of War, for the proper care and safe return of such equipment when demanded, ordinary wear and tear excepted.

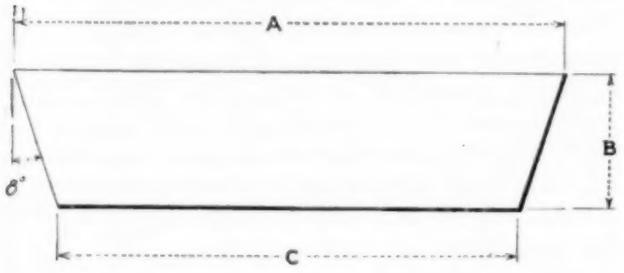
Dies and Plugs for Drawing Brass Tubing

By ROBERT SCHAFER

This article gives the details of manufacture of dies and plugs for drawing brass tubing. Differences in the methods used for the various sizes are discussed and the limits to the reworking of worn dies are defined. Some dangers in the hardening process are mentioned and the average production for each operation is given.

THE manufacture of dies and plugs for drawing brass rod and tubing requires first of all the right steel properly treated. It must be able to withstand without injury the internal stresses and strains caused by a large number of shrinkings. Steel containing about 1.1 per cent. carbon has been found most suitable for this work.

The hardening process, given later, will close in the opening of a die from 0.005 in. to 0.008 in., depending



	A	B	C	
2½"	2 25/32"	2 9/16"	7/8"	
4"	4 3/8"	4"	1½"	
6"	6 3/8"	5 7/8"	2"	
12"	Straight			

FIG. 1. FORGED SHAPE OF DIES

on the size of the hole. This is what is known to the trade as shrinking.

A satisfactory standard for sizes is as follows:

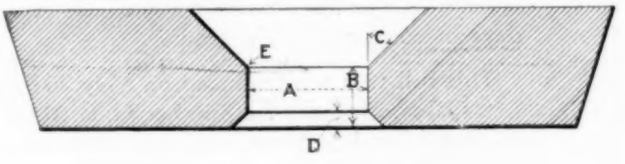
Outside Diameter of Die	Finish Size of Hole	Disk Size Before Forging
2½ in.	0 in. to ¾ in.	2½ in. x ¾ in.
4 in.	¾ to 2½ in.	4 in. x 1½ in.
6 in.	2½ in. to 4½ in.	6 in. x 2 in.
12 in.	4½ in. up to maximum	10 in. x 3 in.

The 2½-in. disks are cut from bar stock and taken direct to a forging press; the 4-in. ones are drilled with a ¾-in. hole in the center before forging; the 6-in. size are drilled with a 2-in. hole in the center and then forged; and the 12-in. disks are forged with a 3-in. hole under a steam hammer. The drilling of the 4-in. and 6-in. blanks is done on a heavy-duty drill, one man drilling 120 of the 4-in. size or 50 of the 6-in. size in 10 hours. After drilling the disks are taken to a forging press and forged to the shape shown in Fig. 1.

Preparatory to forging, the blank disks are heated to 1600 deg. F. in an underfired muffle using oil as fuel. A muffle having an area of 24 x 36 in., or 6 sq.ft., will hold a charge of 200 two-and-a-half-inch dies, 125 four-inch dies or 100 six-inch dies, and will take approximately two hours to bring a charge up to heat. With a vertical-type press, giving an average final pressure of 425 tons, two men will forge 600 dies in 10 hours. After they are forged in this press, the dies are allowed to get cold before being treated further.

When the dies have become cold they are again placed in the furnace and brought up to a temperature of 1400 deg. F. and again allowed to cool in air. This operation is known as the refining process and restores the grain of the steel. The operation is quite necessary, on account of the high forging heat.

After being cooled in the air the dies are again placed in the furnace and brought up to 1400 deg. F.



A	B	C	D	E	F	G
0-¾"	¼"-⅛"	21°	1/16"	¾"	2 25/32"	7/8"
¾"-1 5/8"	⅜"-5/16"	21°	1/16"	¾"	4 3/8"	1½"
1 5/8"-2 3/8"	13/32"-7/32"	21°	1/16"	¾"	4 3/8"	1½"
2 3/8"-3"	7/16"-¼"	21°	5/32"	¾"	6 3/8"	2"

FIG. 2. MACHINING DETAILS OF DIES

and allowed to cool in the furnace. This is called the annealing operation. Annealing requires about 15 hours and about 50 per cent. more dies can be charged into the furnace than was recommended for the forging operation. The furnace is usually started at 4 p.m. and is brought up to heat by 7 p.m. The dies will be cool enough to be removed by 6:30 a.m. the following morning.

The pyrometers used in determining the furnace temperatures must be of proved value as accuracy is essential and must be checked daily against a standard instrument.

The dies in the annealed state are now taken to the soft department where they are machined to the required sizes after which they are ready to be hardened and ground or scraped and lapped as the case may be. In the case of the 2½-in. and 4-in. dies the hole sizes up to 1½ in. are scraped to size and lapped to finish after hardening.

The operations on dies up to the 1½-in. hole size are as follows: First, drill to within 0.01 in. to 0.015 in. of the size; second, rough-ream the mouth; third, finish-ream the bearing; fourth, finish-ream the mouth.

These operations are done on a turret lathe and the average output is 50 dies in 10 hours.

The finish at this stage should be the best possible. If it is well done the scraping operation is almost

eliminated. The dies are now taken to the scraping heads, scraped smooth and polished to a high finish. Gages are used for sizing this operation. They are provided with two diameters, one to go and one not to go. The tolerance is 0.002 in. Scraping heads are just plain heads having two bearings holding the spindle. A clutch for holding the dies is attached to one end. Each head has two speeds, a scraping speed of 150 r.p.m. and a lapping speed of 1000 r.p.m. An

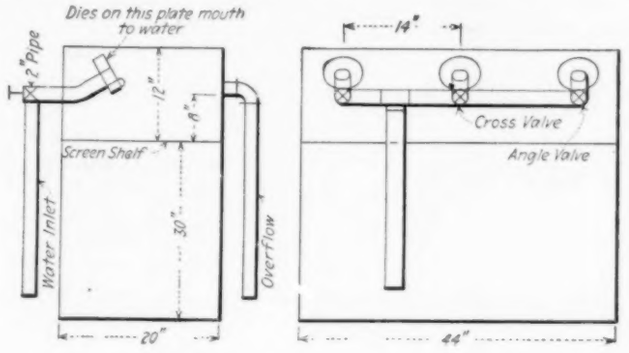


FIG. 3. TANK AND FITTINGS FOR QUENCHING

average workman will lap or scrape about 100 dies per 10-hour day.

Dies having a hole from 1½ in. upward are ground to size, and the following operations are performed in the soft state:

First—Drill to within $\frac{1}{16}$ in. of the size. An average workman will drill 120 dies in 10 hours.

Second—Finish-bore to contour an dhole size in a vertical chucking machine.

Third—Rough-ream to shape.

Fourth—Finish-ream to shape and within 0.005 in. of finished hole diameter.

The latter operation must be carefully done as a good finish here will greatly reduce the grinding time. An average workman will finish 90 four-inch dies or 60 six-inch dies in 10 hours. The 6-in. size is done in the same manner, except that a turret lathe has been found more satisfactory than a vertical chucking machine.

Following these operations the dies are taken to a drilling machine and the back of the hole is chamfered. One man will do the work on 500 dies in 10 hours. The dies are now ready to be hardened and are machined as shown in Fig. 2.

The dies now go to the hardening room where they are heated to a temperature of 1375 deg. F. in a lead pot. After this they are quenched on a spout of water which is so arranged that only the hole is hardened. When the die has become nearly black all over it is thrown into the quenching tank and left until cold. Dies treated in this manner, if of the proper steel, will indicate on the scleroscope from 90 to 100 on the wearing surface, and if fractured will show a carbon penetration of from $\frac{1}{8}$ to $\frac{5}{32}$ in. on the inner surface. The outside of the die remains soft and acts as a retaining ring for the inside.

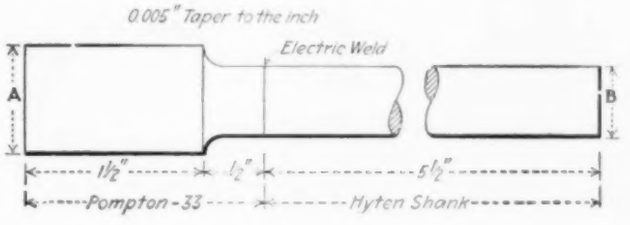
The hardening strains are now relieved by drawing the dies in an oil or electric furnace at 300 deg. F. for two hours. This operation relieves the hardening strains but does not affect the hardness.

The dies are now ready to be ground to finished size. Fig. 3 shows the general arrangement of the tank and fittings for the quenching operation which is called shrinking, for while it hardens the die it also shrinks it so that the size of the hole will decrease about 0.005 in. to 0.008 in. in size.

The above operations apply only to dies that are new. Used dies that have worn badly are treated to the shrinking operation only, after which they are ground out again to the original size. In treating old dies great care must be used to see that no brass sticks to the die before the hardening operation is begun as wherever brass adheres to the die a soft spot will appear and the die will commence to scratch immediately upon drawing tubes through it.

Used dies should not be shrunk and reground more than four times because by that time the outside of the die will have decreased to such an extent that it is below standard and will no longer fit the bench head. At this stage the dies must be reforged, an operation which increases the outside diameter to standard but reduces the thickness. Dies, after being reforged, are treated the same as new dies. They can be reforged until the minimum thickness is reached at which time they are rebored until the wall is too thin to hold, when they are junked.

Grinding or lapping is the next operation in order. This work is done on a grinding machine having a magnetic chuck, a work speed of 100 ft. per minute and a spindle speed of 10,000 r.p.m. This machine should be equipped with grinding wheels whose outside



Under 7/16" use Stub's steel

Size	A	B	
1"	1"	7/8"	
7/8"	7/8"	3/4"	
3/4"	3/4"	5/8"	
1/2"	1/2"	7/16"	
7/16"	7/16"	3/8"	

FIG. 4. DIMENSIONS OF SOLID PLUGS

diameters are 4 in., 3 in., 2½ in., 2 in., 1¾ in., 1½ in. and ⅜ in. thick, of grade M to O and No. 50 grain with a ⅜-in. hole. These wheels have a life of about 8 dies. Such a machine, with one good operator, will turn out 60 four-inch outside diameter dies in 10 hours; 35 five-inch dies in 10 hours, or 8 twelve-inch dies in 10 hours. The amount to be ground out of the dies will vary from 0.008 in. to 0.015 in., due to the variations in the shrinking. Rough-finishing will demand the most grinding. Dies under 1½-in. hole diameter are lapped to size on the lapping heads previously described.

After the dies are lapped or ground they are cleaned in hot caustic soda and rinsed in hot water. From here they are taken to the inspection room where they are inspected for size, finish, shape and hardness.

The length of bearing on a tube die is a very important feature. The following table gives the limits

of length as determined by many tests and experiments on different sizes:

Hole Diameter	Minimum Length	Maximum Length
0 in. to $\frac{3}{4}$ in.	$\frac{1}{16}$ in.	$\frac{1}{4}$ in.
$\frac{3}{4}$ in. to $1\frac{1}{8}$ in.	$\frac{1}{8}$ in.	$\frac{1}{4}$ in.
$1\frac{1}{8}$ in. to $2\frac{1}{4}$ in.	$\frac{3}{16}$ in.	$\frac{3}{8}$ in
$2\frac{1}{4}$ in. to 3 in.	$\frac{1}{4}$ in.	$\frac{1}{2}$ in.

When the bearing becomes shorter than this the tubes are very apt to crack in annealing. If it is longer than the maximum, the extra wearing surface will cause a greater pull and tube points will pull off or the tubes will pull apart. A high finish to the die hole is essential, as it causes the least resistance to drawing. Hardness should not be less than 90, as shown by a scleroscope,

Diam	1" 1 5/16"	1 21/64" 1 9/16"	1 37/64" 2 1/4"	2 17/64" 3 1/2"	3 13/64"-4 1/2"	4 33/64"
Length	1 1/2"	1 1/2"	1 1/2"	2"	2 1/2"	3"
Hole D	5/8"	3/4"	7/8"	1 1/8"	1 1/4"	1 1/2"
Drill	35/64"	43/64"	25/32"	1"	1 5/32"	1 9/32"
Tap	0.635"	0.760"	0.890"	1.138"	1.265"	1.5"
Threads	11	10	10	8	8	6
Radius R	3/16"	3/16"	3/16"	1/4"	1/4"	1/4"

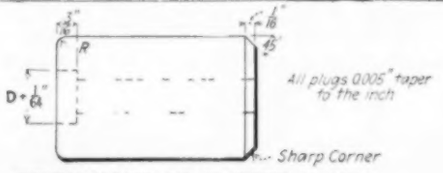


FIG. 5. DIMENSIONS OF TAPPED PLUGS

and a die should draw at least 3000 ft., of tube each time it is ground.

The weight of die blanks is as follows:

Size	Weight
$2\frac{1}{4}$ in.	1.4 lb.
4 in.	5.3 lb.
6 in.	16.0 lb.
12 in.	78.0 lb.

The minimum thickness of a 4-in. blank is $\frac{7}{8}$ in. and of a 6-in., $1\frac{1}{4}$ in. In no case should they be used, after they have been bored with the largest diameter hole, if of less thickness than specified.

Plugs are made of the same grade of steel specified for dies and up to 1 in. diameter are made solid. Sizes 1 in. and upward are made with a tapped hole in them by which they are screwed onto a rod that holds the plug in position. Up to 1 in. diameter, plugs are made on an automatic screw machine which has an output of from 700 to 1000 in 10 hours, depending on the size. The operations are as follows: First, stop to length; second, center and turn shank; third, cut off.

After they leave the automatic they are taken to an electric welding machine where a machine-steel shank is welded on. The sizes of the complete plugs are shown in Fig. 4.

Lapped plugs are made from 1 in. upward in size and up to $2\frac{1}{4}$ in. outside diameter are turned out on an automatic screw machine (with the exception of tapping) having an average output of 250 plugs in 10 hours. The operations are as follows: First, spot drill and counterbore; second, drill and turn within 0.020 in. of the finished size; third, partly cut off, make radius, chamfer; fourth, cut off. Following these operations the plugs are tapped in a tapping head which has an output of 600 plugs per 10 hours with one operator. Fig. 5 shows the various sizes and dimensions.

Plugs $2\frac{1}{4}$ in. and upward are cut off to length from bars on a hacksaw, averaging 250 plugs in a 10-hour day. They are then taken to a turret lathe and drilled, counterbored and tapped, one man averaging 150 in 10 hours, solid plugs $2\frac{1}{4}$ in. and upward are finish-turned in a plain engine lathe to within 0.020 in. of the finished diameter. One man will finish from 50 to 300 in 10 hours, depending on the size.

All plugs are now in their finished state as far as the soft stage is concerned and are now ready to be heat treated. The solid plugs are heated to 1450 deg. F. in a lead pot, quenched in water at 80 deg. and then drawn to 400 deg. for one hour. The tapped plugs from 1 in. to $1\frac{3}{8}$ in. diameter are heated in an oil-fired muffle to 1450 deg. F., quenched in water for 10 seconds and finish quenched in oil, then drawn to 400 deg. F. for one hour. From $1\frac{3}{8}$ in. up to $2\frac{1}{4}$ in. they are heated to 1450 deg. F. in a muffle, quenched in water at 80 deg. F. for 15 seconds and then finish quenched in oil, after which they are drawn to 400 deg. F. for one hour. Plugs $2\frac{1}{4}$ in. and upward are heated to 1475 deg. F., quenched in water at 80 deg. F. for 30 seconds, finish quenched in oil and then drawn to 400 deg. F. for one hour and a half. Lead pots are not used on screw plugs on account of the lead depositing in the threads. Tapped plugs, if finish quenched in water, will invariably develop water cracks from the sharp point at the bottom of the thread. It is therefore essential to finish quench them in oil.

After the plugs are hardened they are ground to size on a plain grinding machine. The operator will grind from 75 to 400 plugs in 10 hours, according to the size. The wheel speed should be 2400 r.p.m., the work speed, 100 ft. per minute, and the wheel used should be 10 in. outside diameter, $\frac{3}{4}$ in. thick and be made of No. 60 grain corundum of L to O grade. The life of such a wheel is about 1500 plugs.

Used plugs, after being worn, are returned to the toolroom, annealed by being heated to 1450 deg. F. and turned down to the next size smaller, and then rehardened and ground. The following premium rates and operations were used by the writer:

Die Grinding

Hole Size	Number per Man per 10 Hours
$1\frac{1}{2}$ in. to 2 in.	40
2 in. to 3 in.	30
3 in. to 4 in.	25
4 in. to 5 in.	15
5 in. to 6 in.	8

Scraping and Lapping

Size	Number per Ten Man Hours
0–$\frac{1}{2}$ in.	100
$\frac{1}{2}$ in. to 1 in.	80
1 in. to $1\frac{1}{2}$ in.	60

Plug Grinding

Size	Number per Ten Man Hours
0 to $\frac{1}{2}$	200
$\frac{1}{2}$ to 1	175
$1\frac{1}{2}$ to 2	150
2 to 3	100
3 to 4	50

Plug Turning

Size	Number per Ten Man Hours
0 to $\frac{1}{2}$ in.	350
$\frac{1}{2}$ in. to 1 in.	250
1 in. to $1\frac{1}{2}$ in.	250
$1\frac{1}{2}$ in. to 2 in.	200
2 in. to 3 in.	80
3 in. to 4 in.	50

Tapping Plugs up to $\frac{3}{4}$ In. 35 per man hour

The treatment given here was developed for Pompton steel, temper No. 33, made by the Ludlum Steel Company, Watervliet, N. Y., and containing 1.1 per cent. carbon.

The Influence of Size on Heat-Treating

By E. J. JANITZKY*

THE influence of size on the physical properties obtained in heat-treating steel has been a topic of much discussion among metallurgists. Elaborate tests have been conducted by various investigators who have attacked the problem rather from a standpoint of experimentation and results obtained than from a theoretical conception based upon the simple mathematical factors involved.

With an increase in the mass of steel there is a corresponding decrease in both the minimum surface hardness and depth hardness when quenched from the same temperature under identical conditions of the quenching medium. In other words, the physical properties obtained are a function of the surface of the metal quenched for a given mass of steel. Keeping this primary assumption in mind it is possible to predict what physical properties may be developed in heat-treating by calculating the surface per unit mass for different shapes and sizes. It may be pointed out that the figures and chart that follow are not results of actual tests, but are derived by calculation. They indicate the mathematical relation, based on the fact that the physical properties of steel are determined not alone by the rate which heat is lost per unit of surface, but by the rate which heat is lost per unit of weight in relation to the surface exposed for that unit. The unit of weight has for the different-shaped bodies and their sizes a certain surface which determines the physical properties.

For example, the surface corresponding to 1 lb. of steel has been computed for spheres, rounds and flats.

TABLE I—SPHERE

Diameter of Sphere X	Surface per Pound of Steel Y
8 in.	2.648 sq.in.
6 in.	3.531 sq.in.
4 in.	5.294 sq.in.
3 in.	7.062 sq.in.
2 in.	10.61 sq.in.
X Y = 21.185	

TABLE II—ROUND

Diameter of Round X	Surface per Pound of Steel Y
8 in.	1.765 sq.in.
6 in.	2.354 sq.in.
5 in.	2.829 sq.in.
4 in.	3.531 sq.in.
3 in.	4.708 sq.in.
2 in.	7.062 sq.in.
1 in.	14.125 sq.in.
0.5 in.	28.25 sq.in.
0.25 in.	56.5 sq.in.
X Y = 14.124.	

For the sphere with a unit weight of 1 lb. the portion is a cone with the apex at the center of the sphere and the base the curved surface of the sphere (surface exposed to quenching). For rounds, a unit weight of 1 lb. may be taken as a disk or cylinder; the base and top surfaces naturally do not enter into calculation. For a flat, a prismatic or cylindrical volume may be taken to represent the unit weight. The surfaces that are considered in this instance are the top and base of the section, as these surfaces are the ones exposed to cooling.

The results of the calculations are as shown in tables I, II and III.

Having once determined the physical qualities of a certain specimen and found its position on the curve we have the means to predict the decrease of physical qualities on larger specimens which receive the same heat-treatment.

When the surfaces of the unit weight as outlined in the foregoing tables are plotted as ordinates and the corresponding diameters as abscissas the resulting curve is a hyperbola and follows the law XY = C. In making these calculations the radii or one-half of the thickness need only to be taken into consideration as the heat is conducted from the center of the body to the surface, following the shortest path.

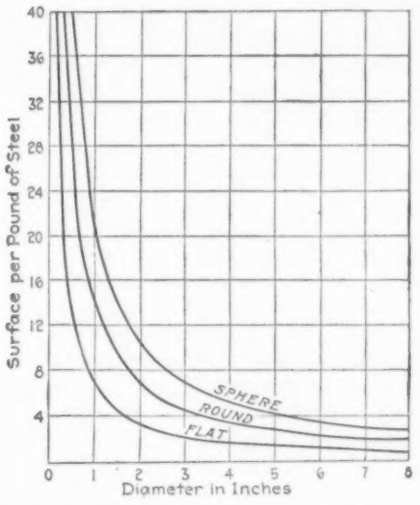


CHART SHOWING THE INFLUENCE OF SIZE AND SHAPE

The equations for the different shapes are as follows:

For flats..... XY = 7.062
For rounds..... XY = 14.124
For spheres..... XY = 21.185

It will be noted that the constants increase in a ratio of 1, 2 and 3, and the three bodies in question will increase in hardness on being quenched in the same ratio, it being understood that the diameter of the sphere and round and thickness of the flat are equal.

TABLE III—FLAT

Thickness of Flat X	Surface per Pound of Steel Y
8 in.	0.8828 sq.in.
6 in.	1.177 sq.in.
5 in.	1.412 sq.in.
4 in.	1.765 sq.in.
3 in.	2.345 sq.in.
2 in.	3.531 sq.in.
1 in.	7.062 sq.in.
0.5 in.	14.124 sq.in.
0.25 in.	28.248 sq.in.
X Y = 7.062.	

Relative to shape it is interesting to note that rounds, squares, octagons and other three-axial bodies, with two

*Metallurgical Engineer, Illinois Steel Co., in the Journal of American Steel Treaters' Society.

of their axes equal, have the same surface for the unit weight. For example:

Size	Length	Surface	Weight	Surface for 1 Lb.
2 in. sq.	12 in.	96 sq.in.	13.6 lb.	7.06 sq.in.
2 in. round	12 in.	75.4 sq.in.	10.68 lb.	7.06 sq.in.

Although this discussion is at present based upon mathematical analysis it is hoped that it will open up a new field of investigation in which but little work has been done, and may assist in settling the as yet unsolved question of the effect of size and shape in the heat-treatment of steel.

Turning Versus Grinding

By J. H. Hollinger

In his letter entitled, "Turning Versus Grinding" on page 648 of *American Machinist*, E. H. Fish leaves one at a loss to know exactly what his sentiments are. He says, "Why not stick to the lathe? There are some jobs on which accuracy cannot well be attained except by grinding, but the greater number of lathe jobs can be finished on a lathe within the limits prescribed." He then turns around and gives very good reasons why the grinding machine has taken a permanent place in the machine shop.

The reason for the success of this machine in the shop is its ability to produce work, smooth, round and true to a greater degree than is possible in the lathe and with a production from 50 to 100 per cent. higher.

Put the same refinements the grinding machine has on the lathe and set the automatic feed to take off the final 0.008 in. as he recommends and see what happens; the surface will be rough, full of holes, out-of-round, torn up and probably somewhere near size. The lathe today is a roughing machine and always will be.

Mr. Fish states that the grinding machine has some well-known limitations. Now it would have been more interesting if he had stated just what these limitations are. It is not expected to grind a thread or do anything ridiculous. The grinding machine today is successfully grinding the general run of work in the machine shop, also a varied line of formed work, external work and internal, and the grinding machine operator is rated higher than the lathe man for no other reason than that the lathe is a roughing tool and the grinding machine an error-correcting one.

The cylindrical grinding machine has helped to reduce the price of automobiles and other machines. Crankshafts are being ground upon it direct from the forging without assistance from the lathe. The same is true with cams. Every part of an automobile that is possible to grind is finished in this way and for no other reason than lowering the cost of production.

Grinding wheels ordinarily used are grades L and M, the average operator preferring a wheel on the hard side. I agree with Mr. Fish that soft wheels are more economical than hard ones, but they should not be so soft as to wear down too rapidly. A soft wheel requires less power to drive it, less expense in diamonds for dressing, and the wheel being more porous and free cutting tends to give a higher rate of production.

The man who understands how to arrange wheel and work speeds to suit the grade of the wheel to the material being ground, is not usually a machine operator, consequently the cause of faulty grinding remains many times a mystery. It requires a specialist, one who has studied the conditions attendant upon the operation of grinding, to secure the best results.

One common fault with operators is dressing the wheel too smooth with the diamond. This error may be pointed out and demonstrated to them, but they drift back to the old way.

Work is sometimes run at an abnormally high speed; yet results are good. This is particularly so when a piece of work is finished in one operation. It is necessary then to run the work a little above normal speed to produce the finish required, but to get a good clean finish it is better to make two operations; the work speed can then be slower.

It is unnecessary to rotate the work fast to secure a high production. Many people have the idea that the work must run fast or the production will be low. If the right wheel is used and the work speeded to suit it the machine will be working under ideal conditions and best results as well as greatest production obtained. A few minutes after a wheel is put into service a good operator will be able to determine whether it is too hard, too soft or just right for the work in hand.

Grinding a Large Die Without Equipment

By James H. Follen

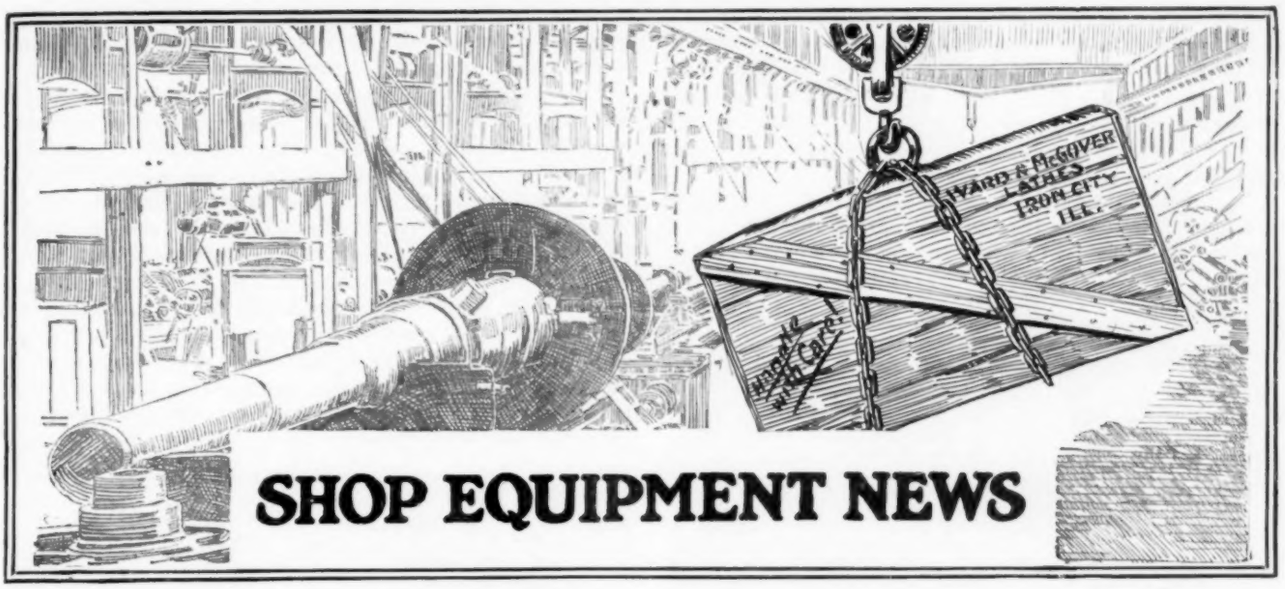
Reading Chordal's letters about the way the men of the old-time shops had to use their heads to do some of the jobs that came along reminded me of a grinding job we had to get out in a small shop of which I had charge about 15 years ago.

This shop made high-pressure tanks for the then popular gasoline-lighting systems and we decided to make a set of combination dies for the bottom and top of the tank and stamp them in one operation, using the same tool for both except changing the center block and knock-out on account of the difference in shape. These dies were a simple lathe job, and as we had no grinding equipment at all except an emery-wheel stand, we had hoped to avoid the grinding as a few burrs on the blanks would not matter. We found, however, that the blanking ring had gone out-of-round about $\frac{1}{32}$ in. in tempering and it would have to be ground inside. The die was about 24 in. outside diameter and we had to have the lathe work done by outside parties as the largest lathe we had in the shop was 18-in. swing.

After a lot of thought we hit on the idea of grinding it in the drilling machine which was an ordinary upright with a round table having the usual round shank set into a bearing on the knee. We turned up a taper arbor to fit the hole in the spindle, threaded it for a nut, made a couple of collars, and mounted an ordinary 8 x 1-in. grinding wheel on it. We then put a larger pulley on the shaft to run the wheel about the proper speed.

The die ring was clamped to the table, using the same threaded holes that held it into the shoe, and after setting the knee and clamping it firmly, the table was revolved by hand by the machinist and a boy, the wheel being fed up and down by hand also. The entire job was finished in one afternoon and made a very clean, accurate blank, from which we made many thousand stampings satisfactorily.

Of course this seems crude nowadays when every shop has several tool-post grinding wheels, but it sure pulled us out of a hole that time.



Newton Radius-Link Grinding Machine

The illustrations show the radius-link grinding machine manufactured by the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Penn., and intended for railroad-shop use. A number of changes have recently been made in this machine, chief among which is that the vertical spindle revolves in an eccentric sleeve which allows for a ½-in. movement front and back. This eliminates the necessity of moving the heavy table and allows for finishing a link without changing the position of the table. Thus, after the machine is set up with a fixed radius center, the adjustment made possible by the front and back movement of the spindle in the eccentric sleeve eliminates the necessity of changing the position of this center when a deeper cut is desired.

The machine has a capacity for grinding radius links with 24- to 100-in. radii, and with thicknesses up to 5 in.; the present design also being arranged to permit the grinding of straight links, or crosshead guides for which the table is arranged with a maximum straight travel of 40 in.

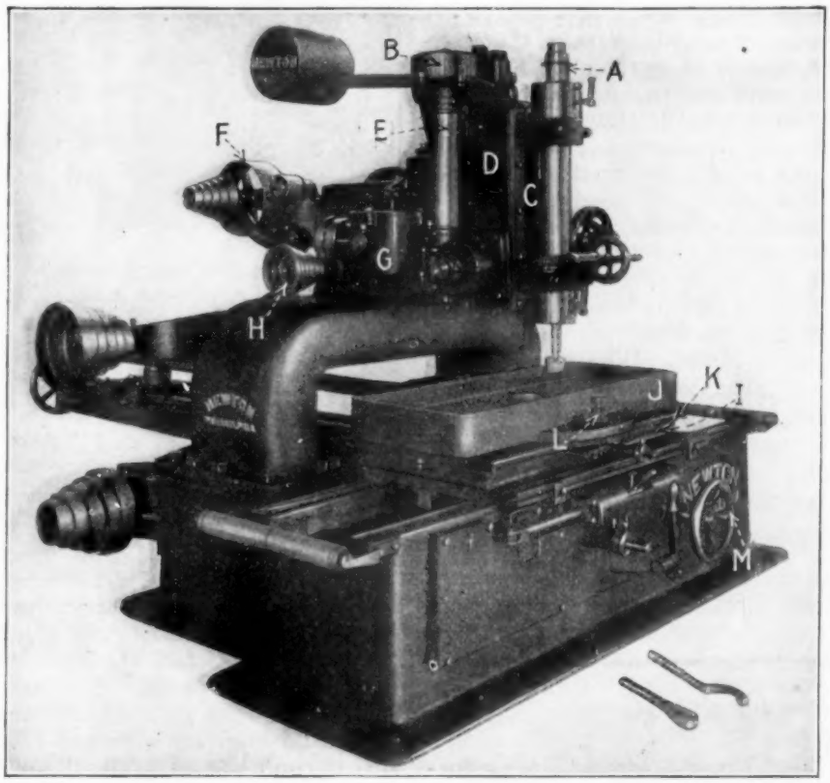


FIG. 1. THE NEWTON RADIUS-LINK GRINDING MACHINE

Capacity of grinding, radii from 24 to 100 in. with thicknesses of the work up to 5 in.; can also be used for straight links with a maximum travel of 40 in.; adjustment of spindle, front and back, ½ in.; vertical oscillating motion of spindle, ⅜ in.

The spindle of the machine is equipped with roller-thrust bearings at the top and bottom, and revolves in an eccentric sleeve, which allows for a ½-in. movement each way front and back. This is controlled by a worm and one-half wormwheel, which is so arranged as to give the full ½-in. adjustment front and back. This permits finishing a link without changing the position of the table. The spindle is driven by a belt connecting pulleys *A* and *B*, and the drive is further carried through the drum *E* and the pulley *F* on the main driving shaft.

The spindle saddle *C*, in which the spindle is mounted, has a vertical oscillating motion of about ⅜ in., which insures parallel wear on the wheel. This oscillating motion is for use on the new design links which have sufficient clearance to permit the use of grinding wheels 2½ to 3 in. in diameter, and of slightly greater lengths than the face of the link.

The saddle *C* is mounted in turn in the saddle *D*, which has power feed vertically in both directions, and is utilized on the older-style links which have only a limited amount of clearance, about an inch or so. This limits the diameter of wheel that

can be used and, consequently, the diameter of the mandrel on which the wheel is supported. The reason for the feed is that the small-diameter mandrels compel the use of narrow-faced wheels as the mandrels would not be strong enough to rigidly support wheels to cover the full face of the link, as is desired wherever practical.

On the bottom of the drum shaft *E* a clutched worm and wormwheel are located to control the oscillating motion of the saddle *C*, while the motion for the reversing feed is taken through the gear box *G* and the cone *H*. There is a scale mounted on top of the radius

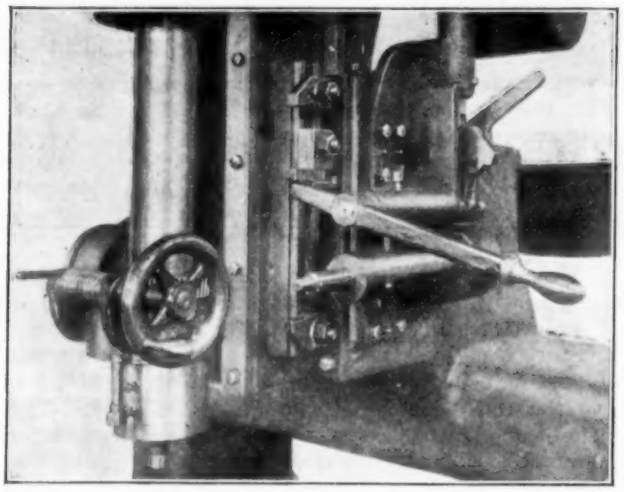


FIG. 2. A CLOSE-UP VIEW OF THE SPINDLE AND ECCENTRIC SLEEVE CONTROL

bar which gives direct readings for radii from the center of the table.

The saddle *I* has reversing cross-traverse on the base, and the table *J* has a pivoted fit to the slide *K* which moves back and forth with the radius control. The pins *L* are to insure the central location of the table while setting the links. The handwheel *M* controls the screw which adjusts the table *J* for depth of cut and from side to side of the links.

The table has automatic reversing motion, and the design is such that the rate of travel to the table may be varied in relation to the spindle rotations. The power vertical feed for the saddle *D* is variable in rate and at most would probably not exceed ½ in. of vertical movement in the complete stroke. Dogs are provided for reversing the motor after the narrow-faced wheel has traversed from the top of the link to the bottom, or vice versa.

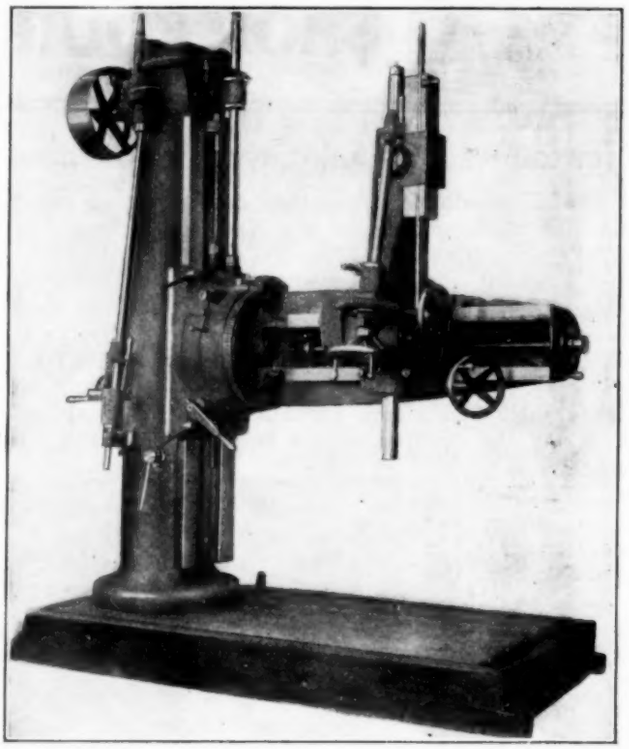
Western Universal Radial Drilling Machine

The illustration shows one of a new line of full universal radial drilling machines that have just been placed on the market by the Western Machine Tool Works, Holland, Mich. It is stated that these machines are powerful and rigid and that the low-hung drive on the lower end of the spindle is superior to the type of drive customarily used.

The bed of the machine has a large working surface with T-slots and is internally ribbed to relieve any tendency to spring, these ribs being of I-section. The bottom of the bed is planed and the bolt holes in the corners are drilled. A channel is cast around the outer edge for collecting the drilling compound, which drains into a reservoir cast in the rear end of the base.

The column is of box section and turns on an inner column that is bolted to the base. The outer column bears on the inner column at three points, top, middle and bottom; the clamping being done about midway of the height of the middle column. The bearing at the top is of the roller type with ¾-in. rollers, while that at the bottom is an annular-ball type with ¾-in. balls.

The gear box is located at the top of the column and gives eight changes of speed through a sliding cone and tumbler gear. Only nine gears are used in all, and none are in mesh except those transmitting the power. The gears and bearings on the inside of this box are submerged in oil to insure proper lubri-



WESTERN UNIVERSAL RADIAL DRILLING MACHINE

Made in three sizes, 4, 5 and 6 ft. Specifications for 5-ft. machine: Maximum distance from face of column to center of spindle, 61 in.; minimum distance from face of column to center of spindle, 26 in.; maximum distance from end of spindle to bed, 66 in.; minimum distance from end of spindle to bed, 0 in.; size of working surface of base, 64 x 44 in.; number of drill speeds, sixteen, 16 to 230 r.p.m.; ratio from pulley to spindle, 1 to 20; speed of driving pulley, 300 r.p.m.; size of driving pulley, 16 x 4 in.; number of drill speeds, four, 0.006 to 0.018 in. per spindle revolution; diameter of driving part of spindle, 2½ in.; Morse taper in spindle, No. 5; traverse of spindle, 20 in.; net weight, 11,000 lb.; box table, 20 x 20 in.; horsepower of motor recommended, 7½; speed of constant-speed motor recommended, 1200 r.p.m.; variable-speed motor recommended, 400 to 1200 r.p.m.

cation. Bearing bushings are bronze and all the shafts are steel ground to size. The changes are made through hand levers at the front of the column, a hollow cylinder with guide slots and plunger holes in its surface serving to locate the eight different positions of the tumbler-gear yoke. Sixteen speeds are possible, eight through the gear box, and eight through the back gears, and these are arranged in geometrical progression to cover a wide range of work.

The saddle is held on the column with adjustable gibs, the bearing being long, to overcome the tendency of the arm to lift under the pressure of a heavy cut.

Clamps are furnished to secure the saddle at any desired position on the column. The elevating mechanism is located in the saddle and is controlled by a lever at the front. Motion for raising and lowering the arm is transmitted through a pair of adjustable friction clutches. The arm is of C-section, ribbed on the inside. The inner end of the arm is graduated in degrees and may be swivelled through a complete circle, the movement being accomplished by a worm and worm gear, the worm-gear teeth being cut integral on the largest diameter. The inner end is recessed into the saddle, four T-bolts being provided for securing it against movement. A dowel serves to locate it in its zero position.

A tapping attachment is regularly furnished, power being obtained through a pair of bevel friction gears on the vertical drive shaft in the saddle. Internal expanding-ring frictions with adjustments for wear control the forward and backward motion, these being mounted on the highest speed shaft, in order to work a maximum efficiency. The head has been made so that the center of the spindle is nearly in line with the center of the column, and all main bearings are provided with bronze bushings. It may be swiveled 45 deg. each side of the perpendicular by means of a segment gear and pinion, or through a full circle when operating by hand beyond 45 deg. Means are provided for locking it in place, and a dowel locates it at the zero or vertical position. The swiveling of the head is entirely independent of the saddle-moving mechanism. The head cannot sag while being adjusted as it is recessed into the saddle. The head saddle is provided with taper gibs for adjustment, and is moved along the arm by means of a handwheel, binder clamps being provided.

The low-hung drive for the spindle is one of the distinctive features, the spindle being driven by a pair of reduction gears at its lower end close to the drill or cutter being used. The large bevel gear is slideably connected to the spindle at its largest diameter by means of two keys. The drive gearing is of steel, the back gears being located at the inner end of the arm, and operated by a lever within reach of the operator.

Four changes of feed are provided, these being obtained through eight steel gears. The present drive makes it possible to use ball-thrust races containing large balls under the feed quill, which is a valuable feature when heavy cuts are being carried. A friction feed release is used which allows the worm to remain constantly in mesh. The feed is provided with an automatic depth gage, the feed also being tripped, when the spindle reaches its limit of travel in either direction. Hand feed is also provided.

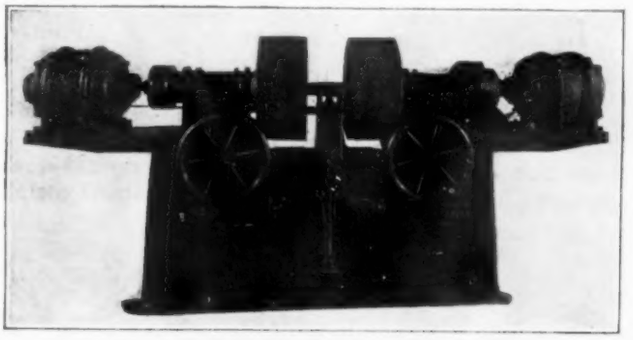
The spindle is counterweighted, this mechanism operating through the rack pinion, which serves to balance the spindle regardless of its angle of inclination.

The drive is from either the lineshaft or a motor as desired, the motors being either of the constant- or variable-speed type. When a motor is used it is placed on a suitable plate bolted to the rear of the column, or if desired it can be mounted on top of the column and geared directly to the vertical drive shaft of the drilling machine.

Box and universal tables can also be furnished if desired. The box tables are planed to size and shape and have T-slots on both the top and sides for securing work or fixture.

Hawes End-Surface Grinding Machine

A grinding machine for finishing the end surfaces of various parts is a recent product of C. L. Hawes, 12 Adams St., Ashtabula, Ohio. The machine will grind the end surfaces of parts from 3 to 12 in. in length, stops being supplied to set to any desired length. The two grinding wheels are driven by direct-connected electric motors. The emery wheels are the cup type, 18-



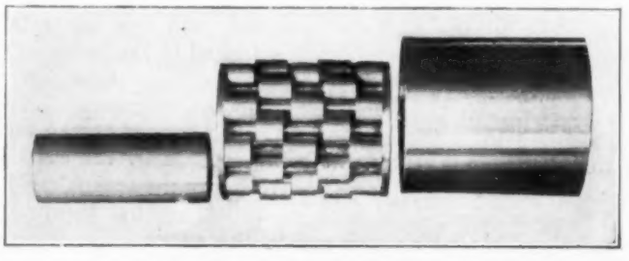
HAWES END-SURFACE GRINDING MACHINE

Capacity, work from 3 to 12 in. in length; wheels used, cup type with 6-in. face, 18 in. in diameter with 3-in. face on cup side of wheel; electric motors, 5 hp., 1000 r.p.m., 60-cycle, a.c.; length of machine, 9 ft.; weight, 2750 lb.

in. in diameter, with 6-in. face, and a 3-in. face on the cup side of the wheel. The bearings are of the Timken roller type. In operation the wheels are moved apart by a foot pedal, the work being placed in a jig between the wheels. When the operator releases the pedal, the wheels close automatically, the jig in the center being moved mechanically across the face of the wheels so that they will wear true and the ends of the work will be ground square. The machine is so arranged that either wheel can be adjusted independently of the other to any desired distance from the center, this adjustment being made by means of the handwheels shown at the front of the machine. The couplings connecting the grinding spindles with the motors are of the flexible type.

Hart Roller Bearings

The Hart Roller Bearing Co., 512 Main St., East Orange, N. J., is now marketing a line of roller bearings that are said to have a number of features that make them desirable. The rollers instead of being made as long as the bearings, are made short and are mounted on alignment shafts supported at their ends by the retainer rings, the rollers revolving freely on these alignment shafts. The rollers are made short and of different lengths and are staggered as can be noted in the illustration. The advantages claimed for this construction are that the bearing angle or the included

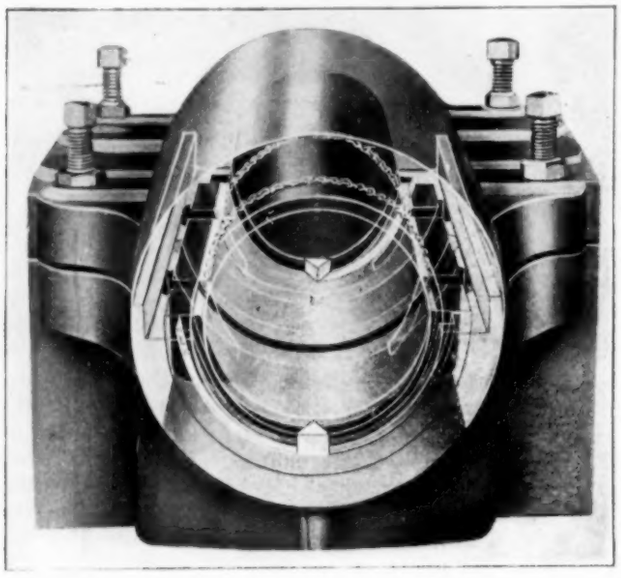


HART ROLLER BEARING WITH STAGGERED ROLLERS

angle between radial lines drawn from the axis of the bearing through the centers of the adjacent rollers is considerably reduced, that the staggered arrangement provides more space for the circulation of oil or grease, that frictional resistance between the cage and the rollers is reduced and that when one end of the bearing is loaded heavier than the other the staggered arrangement gives a greater load capacity than other arrangements. The rollers are made of a special analysis chrome-vanadium steel, heat-treated and ground to size.

Industrial Oil Wipers for Bearings

The Industrial Products Co., 1024 Penobscot Building, Detroit, Mich., has placed on the market an oil wiper for bearings. It consists of a tempered-steel spring with a triangular-shaped piece of babbitt metal

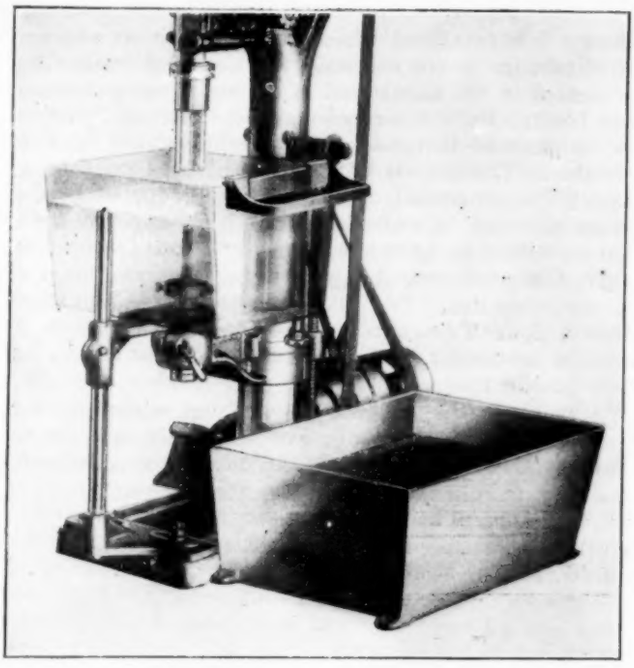


INDUSTRIAL BEARING WIPERS

mounted on one end. This piece of babbit metal is shaped to the shaft, and is said to wipe it clean, returning the oil to the reservoir of the bearing. The spring is fastened to a convenient point in the groove at the end of the bearing or to the housing, there being a wiper at each end of the bearing. The wipers may be applied to plain, roller or ball bearings. It is said that they will hug the shaft under all conditions, and that they will last as long as the bearing itself. The shaft may be run in either direction, as desired.

Hjorth Submerged Drilling Attachment

The Hjorth Lathe and Tool Co., 27 School St., Boston, Mass., is now marketing the submerged drilling attachment shown in the illustration. The upper tank is attached to the drill table socket, and two centering holders, the lower of which is attached to the lower drill table, and the other to the bottom of the tank, allow it to be raised, lowered and kept in alignment. The drill is held in the holder which is fastened to the bottom of the tank, the point being covered by the cutting compound. The drill is self-centering in the socket holder. The tank is provided with an outlet, so that the lubricant can be quickly drained to the lower tank, for removing or changing drills. The drill holder accommo-



HJORTH SUBMERGED DRILLING ATTACHMENT

dates drills from ¼ to 1½ in. in diameter. The work is held in a chuck attached to the drilling spindle, the drill remaining stationary. The advantages claimed are that the work is prevented from heating; that the drill is constantly lubricated, and hence of longer life and that the chips and shavings are kept from sticking.

American Pneumatic Chucks

The illustrtions show two special pneumatic chucks that have recently been manufactured by the American Pneumatic Chuck Co. and sold by the Neidow & Payson Co., 9 South Clinton St., Chicago, Ill. The 12-jaw chuck shown in Fig. 1 will take work 28 to 36 in. in diameter, the jaws having a movement of something over 4 in. each. The chuck is only 3½ in. wide on the outside diameter, and the large number of jaws are used in order to prevent springing the work out of round. In Fig. 1 the chuck is shown with the face-plate both on and off, the latter view giving some idea of the construction. The sliding jaws are moved from the air piston through a rack-and-pinion mechanism. The chuck is operated by a 12-in. standard

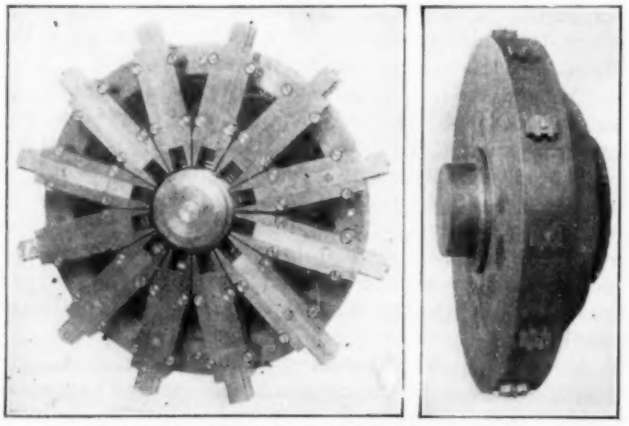


FIG. 1. THE 12-JAW PNEUMATIC CHUCK

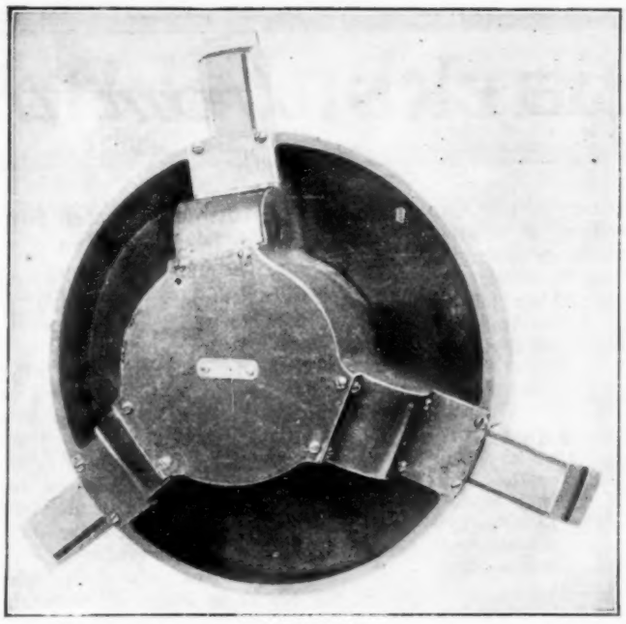


FIG. 2. A 3-JAW PNEUMATIC CHUCK

double-acting cylinder and can also be made for external gripping by using false jaws. It is believed that this is the largest air-operated chuck ever built.

Fig. 2 shows a 3-jaw chuck that is built with somewhat similar construction. This chuck has a range from 17 to 24 in. and is operated by a standard 10-in. double-acting cylinder.

Criticism of Modern Shop Systems

BY H. M. FITZ

I am much interested in the article by J. B. Gray on page 777 entitled, "A Mechanic's Criticism of Modern Shop Systems." If everybody agreed with every one else, please tell me how mistakes and errors would be corrected. The instance he cites, of the confusion caused at first by substituting symbols for the names of tools, is not unusual—in fact, it is to be expected that there will be difficulty in the first change over. The main reason for this is that, heretofore, and it is still the custom in many shops, the mechanic has had to depend almost entirely upon himself for the selection of the proper tools for whatever job he is engaged upon. The idea of substituting symbols for names is to standardize and simplify the handling of tools, by figuring out the proper tools for a certain operation or job, making it a definite instead of a makeshift proposition. This probably would not assist the all-round mechanic as much as the machine operator or machine specialist, but would be especially helpful if he happens to be changed from one job or machine to another.

The instruction card would tell him immediately what tools to use on the job, and just as long as these drawings, tools, jigs, etc., are delivered to him, and everything else required to do the work, what difference does it make to him whether symbols or foreign language are used to designate the tools? In addition to this, many of the shop men operating machines today may know the proper tool to use, but do not know the correct name for it; many do not even know the proper tool to use, and, again, some tools are called by different names in different shops. This is all confusing to tool-crib tenders and shop messengers, resulting in loss of time and often in the selection of the wrong tool. To illustrate this, let me cite two instances that have come to my attention: In one plant, where they were setting up small steam cylinders for mine-sweepers on a planing machine to have front and back planed, a new man was put on the job with no instructions except job and drawing number, nor did he have the assistance of shop-messenger service. He had to find his own drawings and select the proper supplies at the machine, around the shop and in the toolroom. The clamps he found were either too long or too short; some of the bolt heads had to be ground to get them into the slots, while on others the threads were stripped; the nut supply was too low altogether, and the washers were of a dozen different sizes; even the shims and drivers were not right. With this collection of the best to be found, he set up the job, and after getting the things in order and grinding up two roughing tools he was ready to begin work, having used up 3 hr. 20 min. in getting started.

ANOTHER MAN ON THE SAME JOB

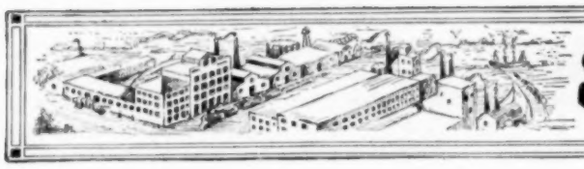
On the other hand, another man on the same job, who was previously supplied with an instruction card and given shop-messenger service, was put to work. Drawings, clamps of the correct sizes and number, bolts, nuts, washers, etc., were delivered to him in good condition, and he was supplied with cutting tools of correct shape and proper grinding. It took this man but 56 min. to make the set-up required, as against the 3 hr. 20 min. for the man without proper instructions.

This same thing would be true if one were going to dig a trench. If tools and equipment were ordered according to symbol, one need not know whether a pick or a shovel, or even a ditch-digging machine is to be supplied. But one thing is certain—the best and most efficient equipment for that particular job will be provided.

In some plants the symbolizing of tools and other scientific methods may not be to the best advantage. When Mr. Emerson installed the bonus system on the Santa Fe, he did not make the mistake of changing the names of tools (if they can be considered as such). The fact that one is raised on goat's milk does not necessarily mean that he is going to stick to that drink all his life. This same thing applies to systems. They may not always fit the conditions and a little change here and there may be necessary for successful working.

We have in mind one plant that was operating four different systems; namely, bonus, premium, piece work and day work. This sounds confusing, but on investigation it would be seen that each had its own advantages, peculiar to the conditions and nature of the work in that particular division. It also showed that whoever installed the systems was not the staunch advocate of any particular cut-and-dried system. We do not say that the conditions could not have been changed to suit any one of the systems, but the advantage would probably not have been the same. The principles of efficiency enter into each of these systems, but are applied in different ways, in order to attain quality and quantity and secure the most accurate record at the best cost.

Criticisms are good, and always have a beneficial and educational effect on some one, and sometimes the critic will see the other point of view after it is explained to him. If, on the other hand, his contention is correct, then the other fellow should profit by the criticism.



Sparks from the

Greater Shipping Service to Latin-America

Chairman Hurley of the United States Shipping Board Announces Plans at the Second Pan-American Commercial Conference

Edward N. Hurley, Chairman of the United States Shipping Board, brought forth the applause of the second Pan-American Commercial Conference when he announced the plans of the Board for extending shipping service between the United States and Latin-America. The great interest shown in Mr. Hurley's speech was evidenced by the large number of questions which were asked him by representatives of the different countries and by business men from different parts of the United States as to these plans.

"Not a Single Country to Be Neglected"

The speaker asserted that "not a single country was going to be neglected" in the greatly enlarged shipping facilities to be provided. He said that every principal port in the United States, on the Altantic, the Pacific, and the Gulf, would be taken care of and they would receive their proper allocation of the shipping.

As to competition he declared that the United States intended to compete in the markets of the world fairly and squarely with other countries and that he had no fear as to the results; but he announced that the vessels flying the American flag would carry only a certain percentage, not more than 50 per cent., of the products, and that this would give all the Latin-American countries full opportunity to make use of their own ships.

Planning a Special Sailing

Mr. Hurley announced that the Board was planning for a special initial sailing from New York about Nov. 1, of the Kronprincessin Cecelie, a former German vessel, now the Mt. Vernon, and that they hoped to make this a record trip to at least three of the South American ports, including Buenos Aires and Rio de Janeiro and that he hoped the members of the governing board of the Pan-American Union, as well as officials of this Government and a large delegation of American business men would avail themselves of the opportunity to take this trip.

Martin Behrman, mayor of New Orleans, one of the speakers at the morning session, declared that "New Orleans is talking big figures and doing big things," and he spoke of the developing friendly relations among all the nations of the Western Hemisphere.

Augustus Post, secretary of the Aëro Club of America, speaking of aviation as an aid to Pan-American commerce declared that "within ten years aircraft will be the most powerful single factor in developing the Latin-American republics economically, socially and commercially."

* * *

Summer Course in Industrial Management

The fourth summer session in factory organization, cost accounting, employment and scientific management will be held at the Pennsylvania State College, Aug. 11 to 23, 1919.

The morning lectures and discussions will be conducted by Maj. Hugo Diemer, formerly professor of industrial engineering at the Pennsylvania State College, but at present superintendent of personnel at the Winchester Repeating Arms Co. Major Diemer's practical experience includes that of superintendent of the National Motor Vehicle Co., Indianapolis; organization manager for the Goodman Manufacturing Co., Chicago, Ill, and consulting industrial engineer for many manufacturing corporations, including the Cincinnati Milling Machine Co., Fairbanks-Morse Manufacturing Co., International Harvesting Machine Co., and as Major of Ordnance in charge of important munitions work at the U. S. Cartridge Co., Lowell, Mass., and the Bethlehem Steel Company.

The afternoon practice work will be in charge of Lieut. J. O. Keller, who has done time-study work at the Aluminum Castings Co., and shop lay-out work with the Austin Co., and served as Lieutenant of Ordnance. Lieutenant Keller is Major Diemer's first assistant in industrial engineering branches at the Pennsylvania State College.

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Italy's Needs in Machine Tools for Expanding Industries

The provision of machine tools for expanding industries after the war is exercising the minds of prominent Italians. One-tenth of these imports before the war was supplied by England, three-tenths by America, and six-tenths by Germany. The last-named country will, however, cease to count among Italy's suppliers, and her requirements will have to be met elsewhere. To this end, says *Engineering*, a company was recently formed at Milan which, pending the time when Italy is able to provide for her own wants, will control the business of machine-tool imports, among which agricultural motors and machinery take a leading place.

Home Institutions Selected for Training Disabled Men

Generally speaking, the Federal Board for Vocational Education is training men in four lines of work; namely, agriculture, industry, commerce and the professions. The belief of the Board, which it endeavors to live up to, is that disabled men should go back to their own states for their training, if possible. The Board is using private commercial colleges for the commercial education of disabled men, because they are accustomed to dealing with individual students, with differing degrees of education, who enter the course at irregular intervals. Land grant colleges are being used for agricultural training, and whenever practical for engineering courses as well. Industrial trade schools and shops and plants of all kinds in many places are being used for the industrial work. The idea of the Board is to keep the men contented during their period of training, and, as a rule this is best accomplished by placing the men near their own people, and among familiar surroundings.

* * *

A Co-partnership Formed in Binghamton, N. Y.

A new co-partnership has been formed in Binghamton, N. Y., to act as manufacturers' representatives and engineers, under the name of the Universal Equipment Co., with offices in the Security Mutual Building.

The firm is composed of T. M. Hutchins, former Binghamton publicity agent for the U. S. Treasury Department; H. L. Ellis, a salesman, and Alvin R. Gilmore, a local engineer.

This new concern will carry on a general business in iron and steel specialties and builders' supplies, lighting, power, waterworks, sewerage-disposal and grading equipment.

* * *

New Incorporations for April

New Incorporations during April had total authorized capital of 516 million dollars compared with 371 million dollars for similar organizations in March and 256 million dollars for the new incorporations of April, 1918. This is a new high record for total capital of new incorporations during any one month since 1900 and probably indicates only a beginning of the growth and development which is to take place during the next year or two. With the bulk of Government financing out of the way capital will be offered more freely for industrial development and the financing of public-service and transportation companies.

World's Industrial Forge

By E.C.Porter, News Editor

Convention of the National Gas Engine Association

The twelfth annual meeting of the National Gas Engine Association was held at the Hotel Sherman, Chicago, Ill., on June 2 and 3, 1919. The presiding officers for the convention were: President, O. H. Fischer, Oakland, Calif.; treasurer, O. M. Knoblock, Chicago, Ill., and secretary, H. R. Brate, Lakemont, N. Y.

The sessions of the meeting were largely devoted to discussions of trade and sales problems. Few papers were presented which had been prepared in advance of the meeting.

The annual election of officers on the last day of the meeting resulted in the following selections: President, L. M. Ward, Cushman Motor Co., Lincoln, Neb.; first vice president, Theodore C. Menges, Associated Manufacturers Co.; Waterloo, Iowa; second vice president, Henry Kennedy, Lalley Electric Lighting Corp., Detroit, Mich.; treasurer, O. M. Knoblock, Chicago, Ill.; secretary, H R. Brate, Lakemont, N. Y. The new members of the executive committee are; Richard De Forest, Alamo Farm Lighting Co., Chicago, Ill., to serve one year; F. E. McKee, Manning, Maxwell and Moore, Inc., New York, to serve two years, and Geo. Cormack, H. C. Doman Co., Oshkosh, Wis., to serve three years.

* * *

A Solution to the Housing Problem

In order to provide proper housing for the employees of its Buchanan, Michigan plant, the Clark Equipment Co., manufacturers of steel-disk wheels and "Celfor" drills, recently purchased a tract of land, plotted it into subdivisions and erected 45 houses and bungalows.

The common practice of the employees paying for their homes on the rental basis has, as a rule, proved unsatisfactory. In the Clark plan the purchasing employee pays on terms to suit his purse, on an amortization plan, so that at the end of a period of years the property is free.

To head off speculators and keep profiteers from grabbing the unearned increment, the company, in fixing the prices, adds 100 per cent. to the actual cost of the lot and 5 per cent. on the cost of the house.

After five years of payments the purchaser has an equity sufficient to guarantee his good faith in carrying the deal through to the end, and the 100 per cent. on the lot and the 5 per cent. on the house are remitted and applied on the account, so the buyer gets his home at actual cost price.

That this plan appealed to the employees is shown by the fact that larger and better houses than are found in the usual run of corporation houses, were desired.

There is also a combined stock sale and profit-sharing plan which is very popular with the employees. The employees are allowed to subscribe for stocks in "lots," which consist of one share each of preferred and common stock, in amounts up to 10 per cent. of their salary. With each lot the purchaser is given an employee's participating certificate which entitles the holder to a minimum dividend of six per cent.

In addition to this there is a distribution dependent upon profit. The combined dividends to participating employees have gone as high as 65 to 70 per cent. on their investment.

* * *

Money in Circulation

Money in circulation on the first day of May totaled 5863 million dollars compared with 5847 million dollars a month ago and 5319 million dollars a year ago. The population of the United States is estimated at 107,311 thousand compared with 105,581 thousand a year ago, making the circulation per capita $54.64 compared with $54.56 a month ago and $50.30 a year ago. The general stock of money in the United States is estimated at 7615 million dollars compared with 7587 million dollars a month ago and 6541 million dollars a year ago.

* * *

Power Required to Make Ferroalloys

The power required to make a number of ferroalloys was recently tabulated in *La Houille blanche* by Director Flusin of the laboratory of electrochemistry and electrometallurgy of the University of Grenoble. His figures give the power, generated in waterpower plants, in kilowatts per 24 hr. required per ton of product made, and also the number of tons of principal raw materials per ton of resultant product. Some of the figures are as follows:

	Kw.-day per Ton	Tons of Materials to Ton of Product
Ferrosilicons:		
10 to 12 per cent. Si.....	109	1.55
25 to 30 per cent. Si.....	172	1.9
45 to 50 per cent. Si.....	333	2.9
70 to 80 per cent. Si.....	714	4.3
90 to 95 per cent. Si.....	1000	6.4
Ferromanganese:		
18 to 12 per cent. Mn.....	67	1.8
70 to 75 per cent. Mn.....	167	3.15
Ferrochrome:		
10 per cent. Cr.....	286	2.9
1 per cent. Cr.....	555	4.05
Ferrotungstens.....	400 to 286	2.7

Trade Currents From Western Cities

Reports from Chicago State that May was the Best Month for the Machine-Tool Trade—Cleveland Reports Less Shopping and More Buying

CHICAGO LETTER

Recent optimistic reports in regard to the condition of the Chicago machine-tool trade are fully justified by inquiry into the actual business done by various dealers during the month just closed. The unanimous expression is that May was the best month since the end of the war, both in sales and collections, and one large dealer states that it ranks second in his entire history in point of sales and first in point of collections.

The large volume of business done, approximating 25 per cent. over that of April, is in sales of from one to a few prices scattered throughout a wide range. The outstanding feature is that the great corporations who have been making inquiries are still deferring their buying, but the smaller concerns are purchasing freely. Trade in machine-tool attachments and small tools has been very lively. There seems to be a particular demand for sheet-metal-working machinery, new and second hand, many dealers reporting inability to fill orders.

Prices are less a matter of speculation than a few weeks ago. The impression is gaining ground that it is a wise buyer who places his order at the prevailing list, as the tendency to stiffen up prices is very noticeable all along the line. It has been strengthened by the announcement by one of the large machinery and small-tools manufacturers that their guarantee to buyers against a decline is withdrawn. Their explanation is that they made a guarantee against decline, upon the signing of the armistice, to protect both dealers and buyers during the period of transition from war to peace; that in their opinion business in the machine-tool industry is now on a firm peace basis, and that such protection is no longer necessary.

Inquiries continue to be received by dealers in such volume as to insure a continuance of excellent business throughout the coming month.

CLEVELAND LETTER

Less shopping and more real buying is the keynote to the opening of June in the machinery and machine-tool field in the Cleveland and northern Ohio district. Anticipation for improvement in the whole equipment situation is being realized because of the contrast in the

early business of this month with that of May at this time. The outstanding feature for the month, in the opinion of leading dealers, will be the inability of producers to make prompt deliveries. In many plants, it is explained, production has been cut, which, under these conditions, brings the present demand to above normal, although it would be sub-normal with a 100 per cent. production. To a certain extent this will mean a shortage of equipment, and distributors consequently are urging their clients to place their orders now if they expect anything like reasonable deliveries.

LARGE TENTATIVE ORDERS COMING FROM COMMISSION HOUSES

Another development of the last week, expected to bear good fruit during the balance of the month, is the larger number of tentative orders coming into the machinery field in this district from commission houses in the East representing foreign firms. It is believed here this is the beginning of the long-anticipated demand from European consumers and tends to offset the predictions that foreign countries would not enter American markets for their equipment needs.

Principal domestic business now being placed is for automatic screw machines, which are being taken largely by automobile, piano and talking-machine interests in other parts of the country. Shaping machines, drilling machines and gear-cutting machines make up the balance of the bulk of business and the remaining orders are scattered over a miscellaneous assortment of equipment. In all quarters most of the inquiries now being received are for equipment that each firm can handle, leaving fewer items unfilled than for several months past.

* * *

Business Failures in April

Business failures during April numbered 503, the smallest number of failures ever reported in any month, which compares with 558 failures in March and 867 failures in April of last year. Liabilities of the concerns failing in April were 11 million dollars compared with 14 million dollars for those failing in March and 13 million dollars for concerns failing in April of last year. No better indication of the solidity of underlying business could be presented. Six months have passed since the end of hostilities and, during that six months of change and readjustment, business failures have been the smallest ever known for a half-year period.

* * *

Opens Employees' Restaurant

The Cleveland Milling Machine Co., Cleveland, Ohio, has opened an employees' restaurant, and will sell food at cost price. This restaurant was designed with the view of accommodating 300 people and has up-to-date kitchen facilities to prepare regular as well as short-order meals.

Business Items

The Cleveland Milling Machine Co., Cleveland, Ohio, has announced the appointment of H. I. Miner as sales manager.

The National Tool and Manufacture Co., St. Louis, Mo., has changed its name to the Bluebird Manufacturing Co., effective June 1.

Barber-Colman Co., Rockford, Ill., has opened a branch office at 451 Ellicott Square Building, Buffalo, N. Y. C G. Kaelin is the manager.

The Union Drawn Steel Co., Beaver Falls, Penn., has opened a branch sales office in Cleveland, Ohio. Fred. C. Young is the district sales manager.

The Kauffman Metal Products Co., Bellefontaine, Ohio, has taken over the H. Murphy Bronze and Aluminum Co., and has increased its capital from $50,000 to $125,000.

The Peninsular Tool Salvage Co., Inc., Detroit, Mich., has dropped the word "Peninsular" from its name and in the future the name of the company will be Tool Salvage Co.

The R. E. Ellis Engineering Co., Chicago, Ill., will handle the agency for Horstmann indicating calipers which were recently described in the New Tool Section of the *American Machinist*.

Leeds & Northrup Co., Philadelphia, Penn., has recently opened a sales and service department at 1304 Monadnock Building, Chicago, Ill. Henry Brewer will be in charge of the new branch office.

Peter A. Frasse & Co., 417 Canal St., has recently been chosen as the exclusive agency in New York City and vicinity for the Walcott Lathe Co., and the Jackson Shaper Co., both of Jackson, Mich.

The Heine Safety Boiler Co., manufacturers of Heine water-tube boilers, with plants at St. Louis, Mo., and Phoenixville, Penn., has secured the services of Chas. H. Stoddard as its consulting marine engineer.

The Niles-Bement-Pond Co. has opened a new office and store at 116 South Ave., Rochester, N. Y., and will carry a stock of Pratt & Whitney machinist's small tools. Another office has also been opened at 454 East Third St., Los Angeles, Calif.

The Schiotz Tool, Gear and Machine Works, Inc., Waterloo, Iowa, has recently opened a plant with O. W. Schiotz as president and manager. Mr. Schiotz during the war was connected with the Grey Machine Tool Co., Buffalo, N. Y., holding the position of factory superintendent.

On Apr. 29, a charter was granted by the State of Pennsylvania, to the Roberts Co., with offices at 1049 Drexel Building, Philadelphia, to conduct a consulting and contracting engineering business. This company will engage itself in covering the rolling mill, steel plant and special machinery fields. A L. Roberts, has been elected president, and V. F. Signorelli, secretary and treasurer of the new company.

Whitman & Barnes twist drills are to be on exhibition at the convention of master mechanics, to be held at Atlantic City, June 23 to 25. R. A. Ammon, New York office; J. C. Scanlon, Chicago office; Kennith Grant, salesman; A. A. Williams, salesman; Ralph Templeton, salesman; Karl Kendig, advertising manager of the "W & B" company, and J. K. Booth, master mechanic of the Bessemer & Lake Erie Railroad are to form a party to attend the convention.

The Joseph Dixon Crucible Co. of Jersey City, N. J., has announced the removal of its Philadelphia sales office from 1020 Arch St. to Rooms 801 and 802 of the Finance Building, South Penn Sq., Philadelphia, Penn. The Philadelphia sales district comprises Pennsylvania, southern New Jersey, Delaware, Maryland, District of Columbia, Virginia and West Virginia. The Dixon sales organization in Philadelphia is under the management of W. G. Stringer.

The Railroad and Power Equipment Co., Woolworth Building, N. Y., has received many inquiries for machinery and equipment from England, Belgium, France, Spain, Italy, Bulgaria, Greece, China, Japan, India, Panama, Chile and Argentine. This company was recently incorporated under a Delaware charter with $5,000,000 authorized capital stock, to take over the business conducted during the past 20 years by Charles F. Johnson, in New York, Buffalo, Cleveland, Philadelphia, Chicago and Toronto.

The firm of Young, Corley and Dolan, Inc., engineers and contractors and manufacturers' representatives, formerly 115 Broadway, New York, has moved into the five-story building which it purchased at 28-30 West Broadway, where its executive offices, showrooms and warehouse will be combined. This company recently opened offices in various parts of Europe with the principal office in Paris, France. It also has an office in Japan. The officers of the firm are R. A. Corley, president; L. R. Williams, vice president, and D. J. Dolan, secretary and treasurer.

The Tacony Steel Co., Philadelphia, Penn., announces the results of its recent election: J. B. Warren, secretary and general manager, was elected president and general manager; George Satterthwaite was chosen vice president and treasurer, and Henry T. Stetson was made secretary. Messrs. Warren, Satterthwaite and Stetson, with O. W. Bird, Jr., W. C. Witherbee and W. H. Turner compose the present directorate. The company also announces the opening of a New York district sales office at 2 Rector St., and several other district offices throughout the country will be organized